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Striped Muscle Fibre of Pig.

By E. M. Nelson, F.R.M.S.

Plate II, fig. 5.

(Taken as read, November 20th, 1891.)

When microscopists became possessed of a new and more powerful eye by the advent of apochromatics, among other things, I examined striped muscle fibre, and immediately saw several new stripes in the darker portion which lies between the well-known stripes of Huxley and Busk, or Krause's membrane. These were described by me at the R.M.S., November, 1887. Since that time my previous records have been confirmed by examination with monochromatic light, and the fibre has also been successfully photographed; the excellent drawing from which the figure was engraved was kindly made by Mr. G. C. Karop, from one of the photographs.

First, my opinion is that, if anything is to be done towards the elucidation of minute histological structures, we must attack them precisely as if they were diatoms. There should not be such a thing as one way of examining a histological specimen, and another way of examining a diatom; but there is a right and a wrong way of using the microscope, and the right way is the diatom method, and is the one which should be employed on histological tissues.

I would, therefore, most earnestly enjoin all microscopists who wish to explore more minute and still unknown regions of histology, to pay not the slightest heed to Abbe's paper on the wide-angled cone of illumination, but to work away at even difficult and most unpromising structures with the wide-angled cone. What more unpromising structure could you have than that under present discussion, viz., an exquisitely thin and very transparent substance in a fluid of nearly its own refractive index? It should also be remembered that, after a battle of

fifteen years, the truth of the perforated diatom structure, as seen under a wide-angled cone, has been conclusively *proved*, in spite of the most emphatic utterances about the impossibilities of doing so; what has been done with diatoms may be done with histological tissues.

In the first place, the minuteness of an ultimate fibril is not sufficiently recognized. The following measures compare favourably with those in my former paper, which were not those of the same specimen, and which were not measured photographically.

The single fibril here is $\frac{1}{14000}$ inch in diameter; its thickness is probably $\frac{1}{60000}$ inch (estimated, not measured), and the distance from one membrane of Krause to the next is barely $\frac{1}{10000}$ inch. This small portion contains no less than eight stripes. Their order is as follows:—

1st. The very dark and conspicuous membrane of Krause.

2nd. A very bright stripe.

3rd. A faint dark stripe.

4th. A light stripe, not nearly as bright as No. 2.

5th. A dark stripe, darker than No. 3, but not as dark as No. 1.

6th. A light stripe, similar to No. 4.

7th. A dark stripe, similar to No. 3.

8th. A very bright stripe, similar to No. 2.

After this we come again to the dark membrane of Krause. Each band, therefore, may be said to be about $\frac{1}{80000}$ inch in diameter—this, of course, supposing them to be all equal.

In the early days of microscopy nothing but the coarse, alternating white and dark bands were seen; and it is to these coarse bands that "striped muscular fibre" owes its name. What is now called Krause's membrane, viz., the conspicuous dark line traversing the white band, has been known for long. It is figured in a plate dated 1852; there is no doubt it could have been easily seen with objectives constructed after, say, 1841. The next we have is an alleged bright stripe dividing the large dark portion between the Krause membranes into two equal parts. This, which is called Hensen's stripe, has been frequently the subject of controversy, some saying that it is an optical ghost. If you will look at the figure you will see no white stripe, but in place of it a very narrow dark stripe, with a white one on either side of it. You will notice that, in my

former paper, it is stated that I had seen two white stripes, one on either side of a known dark stripe; but now we have a dark stripe in the middle of a known white one. The explanation of this is that the previously known stripe was an optical ghost, which became white or black according to focus, due to the customary small cone of illumination. Therefore, if it is called black, my discovery consists of two white stripes; and if it is called white, then mine is a black stripe. What I claim is that, instead of one stripe, be it black or white, there are three, in the order of white, black, white.

The most important point in the photograph which has been faithfully represented by Mr. Karop is in the last dark space but one from the bottom. Here the new dark stripe protrudes beyond the edge of the fibrilla. This affords a conclusive proof that this stripe is an entity. In my anxiety to secure this detail another is sacrificed. A drawing which combines the points gathered from several photographs would probably explain the subject more clearly, but as these points have been so much controverted, it is perhaps better to keep to the one negative. In some of the photographs a longitudinal white stripe is seen, which apparently divides the fibrilla into two portions. It is this longitudinal white stripe which gives that beaded appearance which has been often noticed. It will be observed that it is the white portions which are the weaker, the fracture always occurring there. On the left-hand side there are no less than three fractures taking place at the transverse bright white stripes and one at the longitudinal. It would seem that what we have called an ultimate fibrilla of $\frac{1}{14000}$ inch in diameter is almost ready to break into two fibrillæ, each being $\frac{1}{28000}$ inch in diameter.

The longitudinal white stripe is not so strongly marked where it crosses the Krause membrane, and it is very likely owing to that fact that the fibrilla has not split up. The above structures, in comparison to those of diatoms, are coarse, and of their being entities there cannot be the slightest doubt. With regard to the physiological theory of the action of muscle I, have no knowledge, but it is evident that theory must square with the structure of muscle as we find it, and not, as is often the case, the structure made to square with an *à priori* theory. The magnification is 1,750 diameters.

On Mounting "Selected" Diatoms on Slip.

By H. Morland.

(Read December 18th, 1891.)

In a paper on mounting the Diatomaceæ which I read before the Members of this Club some three years ago, I there stated that it was my practice to mount "selected" diatoms on the underside of cover-glass, and that far too often I found the gum by which the diatoms were fixed showing up in a most objectionable and unpleasant manner when the mount came to be viewed under the microscope. So long as diatoms are fixed on the underside of cover-glass I see no way of avoiding this mishap with any degree of certainty, particularly if the diatoms be mounted with the outer surface next to the gum or other fixing cement.

In the old days of high power "dry" objectives it was a matter of absolute necessity to have the diatoms close to the cover by reason of the extremely short working focus of these objectives, but now that homogeneous immersion lenses are almost universally employed for the higher powers, and as these lenses have a considerably greater working distance, this absolute necessity of the diatoms being in actual contact with the cover-glass may be said to no longer exist, at least, not in 999 cases out of a thousand; all that is necessary is to have the diatom well within the focus of the objectives.

Messrs. Zeiss and Co. in their pamphlet, when introducing the apochromatic lenses to the public, claimed that their highest power lens with their highest N.A. (viz., the lens of 2 m.m. and 1·40 N.A.) will work through a cover-glass of ·25 m.m. (or $\frac{1}{100}$ of an inch) thickness. By far the larger proportion of homogeneous lenses have ample working distance, and so long as I have $\frac{1}{100}$ of an inch at my disposal I have sufficient room, and to spare, in which to mount my diatoms direct on to the slip instead of on to the cover.

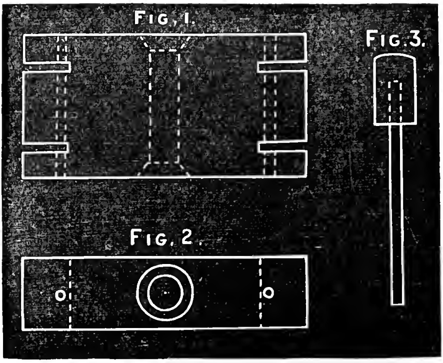
The advantage of mounting on the slip is that as most

diatom-valves are hollowed out with an edge on a flat plane, these valves can be fastened down with the hollow side next the slip, merely resting on the thin outer edge, and with their outer surfaces uppermost and nearest the observer. This obviates all clogging of fine structure by the gum, and though air may be boxed in under the valve, yet as the structure of the diatom-valve is generally cellular and permeable by the balsam, this latter is almost always able to displace the imprisoned air under the valve. Another advantage is that when a valve happens to be very convex it is an exceedingly difficult affair to mount such a valve squarely if resting on the convex side; moreover, as a rule, the outer surface of a diatom is far more interesting to observe than an inner surface, which in many forms consists simply of "eye-spots."

The diatoms having been mounted on the slip, it is necessary to so arrange that the cover-glass shall be brought down sufficiently low as to bring the upper surface of same well within the working distance of the objective. This I manage, firstly, by having cover glasses not exceeding ·005″ in thickness; and, secondly, by gumming three small metal discs, ·003″ thick, in a triangle round the "selected" diatoms, each side of the triangle being about $\frac{3}{16}$ of an inch. When the balsam is applied and the cover-glass put on over same, and pressed down close to the metal discs, it follows as a matter of simple addition that the upper surface of the cover-glass is only ·008″ from the upper surface of the slip, so that with an objective of ·01″ working distance, the observer would be able to not only focus every part of the diatom, but even beyond into the slip itself.

So far as regards these metal discs, I may add that they are of about $\frac{1}{25}$ inch in diameter, and in the first instance I prepared them from some thin copper garden labels (Chandler's patent), of which I had purchased a half-gross for trial in my garden. Noticing that these 72 labels, when placed one above the other, were less than $\frac{1}{4}$ inch in height, it struck me that I had here a material sufficiently thin to place between a slip and cover, giving ample room for diatoms lying flat, and yet allowing an objective of not more than $\frac{1}{100}$ inch working distance to focus down into the slip itself. My die is simply a piece of cast steel, as shown in Figs. 1 and 2, $1\frac{1}{2}$ inches long, $\frac{3}{4}$ inch deep, and $\frac{3}{8}$ inch thick, with a $\frac{1}{25}$ inch hole drilled through the

depth $\frac{3}{16}$ inch from either end, the die being afterwards sawn from the ends a little beyond the drilled holes. A hole is drilled through the centre of the die, by which the same can be fastened down on a board or table as may be desired. The die must, of course, be finished off by being duly hardened and tempered. The punch consists of a piece of steel drill-rod (Fig. 3) accurately fitting the small hole, with one end filed off perfectly square, and the other end provided with a brass or copper head driven on for receiving the blows when in use.



I may say that the die as shown is doubly reversible, viz., end for end and top for bottom. To use the die and punch, enter the latter in one of the holes as far as the upper edge of lower saw-cut, and, after placing the thin copper in the saw-cut, tap the punch lightly with a very small hammer, when a small copper disc will be pushed out below. After a supply of discs has been punched out they will require flattening as they leave the die slightly cupped, which adds to their height. To flatten them I simply place a dozen or so on a thick glass slip, and with another thick slip press them flat. It is as well to boil the discs in soda to free them from any grease, and then to pickle them a short time in aqua fortis, finally washing them well in several changes of boiling water to get rid of all traces of acid, drying off in a hot oven and corking them in a dry specimen tube to preserve them from damp, which otherwise would cause these copper discs to slightly oxidize and tinge the balsam green when in use.

I have lately been turning my attention to the employment of thin aluminium in lieu of copper as being free from the risk of tingeing the balsam through becoming oxidized. I find that this metal can be obtained rolled in thin strips about three inches wide, $\frac{1}{1000}$ inch in thickness and upwards. This metal as purchased is hard and elastic, and therefore requires to be annealed, as otherwise it would be difficult to properly flatten the cupped discs after they leave the die. I find it can be annealed and rendered very similar to thin copper to the touch by simply moving the thin metal to and fro in the flame of a spirit lamp, taking care not to burn the metal by overheating. It will be known when this process is complete by the behaviour of the aluminium when handled by being passed between the fingers. For general use I consider that discs of from ·002″ to ·003″ are amply thin enough, but I have prepared some as thin as $\frac{1}{1200}$ inch in thickness. These latter, however, I could only use in very exceptional cases.

In lieu of metal discs thin glass squares can be employed, but it is difficult to obtain sufficiently thin glass. To cut very small squares, viz., of $\frac{1}{25}$ inch, or even as small as $\frac{1}{50}$ inch, fasten a piece of thin glass on a square piece of brass by means of tallow; then, if this piece of brass be fixed just below the surface of a planed board, the glass can be cut up as desired by means of a writing diamond and a marquois scale and square. Remove the cut-up glass by heat, and boil the small glass squares in soda and water to get rid of the tallow.

As the surface of glass slips is very often far from being all that could be desired, it is as well sometimes to first mount a cover on the slip, and arrange and fix the diatoms on the upper surface of this cover-glass, finishing up with a smaller cover.

It must by no means be supposed that I have given up mounting on the underside of cover-glass. I still continue to do so in the majority of cases, only adopting the method now described when thought advisable.

A Simple Method of Finding the Refractive Index of Various Mounting Media.

By E. M. Nelson, F.R.M.S.

(Taken as read, January 15th, 1892.)

Provide two precisely similar equi-convex lenses, whose identical refractive index, μ, and radii, r, are known, and cement them together with the mounting medium whose refractive index has to be determined. Now measure F, the principal focus of the combination, then the refractive index of the mounting medium.

$$\mu' = 2\,\mu - 1 - \frac{r}{2F}$$

It is convenient to make the radii of the equi-convex lenses two inches. Then —

$$\mu' = 2\,\mu - 1 - \frac{1}{F}$$

Some examples might be of interest.

Let the refractive index μ of the two equi-convex lenses be $\frac{3}{2}$, and suppose that the combination has no focus, that is, that it behaves like a piece of plane glass, then $F = \infty, \frac{1}{F} = 0$, and $\mu' = 2\,\mu - 1 = 2{\cdot}0$.

If the principal focus of the combination $F = +2$ then $\mu' = 2\,\mu - 1\frac{1}{2} = \frac{3}{2}$, or the same as that of the equi-convex lenses.

But if the principal focus of the combination F is negative, it must be measured in the same way as a concave spectacle lens, viz., by neutralizing it by a positive lens of equal focus.

If F is negative the sign before the fraction will be changed. Example, let $F = -2$. Then —

$$\mu' = 2\,\mu - 1 - \frac{1}{-2} = 2\,\mu - 1 + \tfrac{1}{2} = 2{\cdot}5.$$

The above method gives a greater range of readings for indices varying from 2·0 to 2·5, and consequently more accurate results than the simpler one of filling up a plano-concave lens

with the medium, and covering it with a piece of plane glass. The formula for this latter plan being $\mu' = \mu + \frac{r}{F}$. The radius of the concave r might with advantage be made two inches, then $\mu' = \mu + \frac{2}{F}$.

If $\mu = \frac{3}{2}$, and $F = \infty$, $\mu' = \frac{3}{2}$; if $F = 4$, $\mu' = 2{\cdot}0$; and if $F = 2$, $\mu' = 2{\cdot}5$.

Note on a Species of Ixodes found upon a South African Lizard.

By R. T. Lewis, F.R.M.S.

Plate I.

(*Read January 15th, 1892.*)

During the past year I have on several occasions received from a correspondent in Natal specimens of ticks, to which special attention was drawn on account of the serious injury inflicted by them upon domestic animals, especially horses and cattle. On mentioning the subject to a friend, who had been for some years resident on an ostrich farm in the colony, I was assured that the family was so well represented there that nothing seemed to escape them; that they varied in size from scarcely visible specks to about $\frac{3}{4}$in. in length, and that birds, beasts, reptiles, and human beings were alike the objects of their unpleasant attentions.

My friend went on to describe the nature of the bites inflicted, the after consequences of which were always seriously aggravated by too hasty attempts to forcibly remove the creatures; such being the tenacity of their hold that they usually suffered the body to be dragged from the head rather than let go, and the rostrum being thus left imbedded in the flesh gave rise to inflammatory swellings known as Natal boils, which became more or less troublesome according to the season and state of health of the persons bitten. Most of the species sent appear to be such as are only too well-known as cattle pests; but last month I received three samples of a kind which proved to be more rare, for although there are several specimens in the collection at the British Museum, they are at present unnamed, and, being presumably undescribed, may therefore be made the subject of a note of some possible interest to the members of the Club. They were found upon a species of *Iguana* which lives in the marshes, but is said to be unlike the American form

in having a comparatively small and short body and a very long, thin tail, which it switches about like a whiplash. So far as can be judged by the description given and a portion of the skin sent, this reptile is probably a *Varanus*, several species of which are known to inhabit the district, and as the ticks in question are usually found grouped together under the lizard's tail, the irritable movements already alluded to would seem to be thus abundantly accounted for.

Attempts to dislodge these ticks uninjured proving fruitless, a portion of the skin to which three were adherent was sent to me by post; on arrival I found them dead and perfectly dry, but with some trouble and much care I succeeded in detaching them, and in two cases without injury to the mouth organs. As regards size, each specimen measures 2·4 m.m., or one-tenth of an inch in breadth, with a length, exclusive of the rostrum, of 2·6 m.m. The dorsal surface (Plate I, fig. 1) is, in colour, a rich purple brown, with nine sharply-defined, irregularly-shaped patches of a bright yellow tint, the whole being pitted with numerous dark spots, which have the appearance of being the remains of follicles, from which at one time hairs arose; in texture it is hard and unyielding, preserving its natural shape and contour in the desiccated condition. The ventral surface, on the contrary, is, during life, soft, elastic, and pleated into many folds, so as to admit of considerable augmentation in the size of the abdomen when gorged with alimentary matter.

The eight legs have seven joints each, of which the coxa is armed with a hard spinous process, and the terminal joint of the tarsus is furnished with two claws and a number of hairs, two of which are of considerable length. On the median line, near to the posterior end, there is a well-marked anal orifice, but the position of the ovipositor is only made out with difficulty between the basal joints of the second pair of legs. The external organs of respiration are two very clearly-defined stigmatic plates of oval shape a little within the marginal line, a short distance to the rear of the fourth pair of legs. The general colour of the ventral surface is dark chrome yellow, with the legs a russet brown. The greatest interest, however, naturally attaches to the mouth organs, which, when examined under the microscope, are seen to comprise means of offence of a very formidable kind; but an accurate and exhaustive de-

scription of them is unfortunately beset with difficulties, requiring, as it would for its completion, the examination of many specimens, living as well as dead, together with dissections and preparations, for which the present supply is entirely inadequate; added to this, each independent writer upon the subject seems to have adopted a different view as to the homologies of the parts, resulting in many synonyms and a confusion of nomenclature, which, to say the least, is a little bewildering.

The most, therefore, that I can hope to do on this occasion is to describe the appearance presented by such portions as are visible in the dried specimens, which at least have the advantage of being unaltered in shape or relative position by any processes of preparation or pressure in mounting.

I am, however, much indebted to my friend, Mr. Thomas Curties, for kindly placing at my disposal for purposes of comparison some excellent slides of various ticks, which have been of material assistance in tracing their analogies. The rostrum, as seen in profile (Fig. 2), consists mainly of two parts, separable from each other, but with their adjacent surfaces so true as to admit of the closest contact between their outer edges. Of these the lower, or ventral portion, is commonly termed the labium. The upper portion, which is slightly longer than the labium, is bevelled off downwards near to the apex, from which the ends of two pairs of cutting instruments are seen to project. Viewed from above (Fig. 3), it gives the impression of being formed of two parallel tubes, ·55 m.m. in length, with a combined breadth of ·2 m.m., laid side by side, and fused together along the line of contact; certain it is that they are tubular throughout, and that one purpose which they serve is that of a protecting sheath to the cutting tools or mandibles within. Specimens of allied species, prepared so as to be almost translucent, and mounted in balsam, show the mandibles passing freely through, and enable them to be clearly traced backwards to their muscular attachments behind the head. A well-marked median suture suggests the idea that these sheaths were at one time separate; but experiment shows them to be so no longer, although they have in one or two mounted specimens become so, as the result of maceration and flattening under pressure.

When looked at "end on" (Fig. 5), or in transverse section,

it is seen that the line of fusion is not equally well marked above and below, but that whereas a slight groove only remains upon the upper surface, there is one of considerably greater depth and breadth below. A pair of palpi arise from the ventral surface of the head adjacent to the base of the labium; these are four-jointed, the second joint being considerably longer than the others, and the fourth (scarcely discernible in a dried specimen) is furnished with a circular tuft of apparently sensory hairs.

One of the characters of the genus *Ixodes*, given by Van der Hœven and others, is "palpi sheathing the rostrum," which these can scarcely be said to do, although in a large specimen of cattle tick, still alive in my possession, I notice that these palpi are, when at rest, brought up close to the sheath, and that the terminal joints are bent towards each other as if to afford additional protection to the apices of the mandibles. In every species yet examined the whole rostrum is capable of being moved through an angle of at least 90° from the horizontal downwards by the elevation or depression of the head. It will be seen from Fig. 4 that the labium, as viewed from its under side, contracts in breadth from its base for about half its length, thence expanding again, but at the same time diminishing in thickness so as to resemble in shape the convex side of the bowl of an ordinary bone egg-spoon. The part nearest to the base is ribbed, and has the appearance of possessing great rigidity and strength, whilst the spoon-shaped portion is set with six rows of triangular barbs, seven in each row, and all pointing downwards and backwards, at an angle of about 35°.

The structure of the lacinia—or mandibles, as most authorities term them—is not so easily made out; but repeated examinations of each available specimen in many different ways, and a comparison with an allied form found upon a tortoise, lead to the conclusion that there are two pairs, which differ in shape, and are capable of independent movement within a radius at least equal to the semi-diameter of the rostrum. The outer pair (Fig. 7) are nearly flat, the apex being smooth at the back, but furnished on the opposite margin with three lancet-shaped teeth, pointing outwards, and apparently sharp on both edges, so as to cut equally well with a backward or forward thrust. The inner pair (Fig. 6) are more peculiar in shape, the shaft being deeply hollowed like the blade of a gouge, expanding to-

wards the apex, and terminating with a curved spear-shaped tooth, flanked at a short distance below by two others, the points of which are very fine and slightly recurved. These denticulations, like the others, also point outwards, and when withdrawn within the sheath the flat back of the first blade lies within the hollow of the second for mutual protection and economy of space (Fig. 8).

The structure of the entire arrangement suggests the *modus operandi* to be as follows: An incision made in the epidermis by the first pair of mandibles is enlarged and cleared by the scoop-like blades of the second pair, the tapering end of the rostrum being inserted and continually pushed forward into the orifice until the blood-vessels are reached, and in like manner cut through. By the muscular expansion of the abdomen (?) the blood is then freely drawn up the suctorial tube, formed by the groove between the labium and the under surface of the sheath. The resistance offered to any forcible withdrawal by the holding power of the forty-two barbs on the labium is sufficiently obvious, and, apart from such inflammatory action as might arise from the labium being broken off and left embedded in the flesh, it seems clear that in any case a wound so produced would be a source of more lasting annoyance than the more cleanly cut incision of the familiar flea.

Although I have not been able to find this species figured in either of the illustrated works consulted, it would be rash to assume at present that it has not hitherto been either named or described. Otherwise I should venture to propose that it be called *Ixodes varani*, as indicating the source of supply.

Explanation of Plate I.

Fig. 1.—Dorsal view of tick. × 20
„ 1a.— „ „ natural size
„ 2.—Rostrum—lateral view. × 45.
„ 3.— „ —dorsal „ „
„ 4.— „ —ventral „ „
„ 5.— „ —end „ „
„ 6.—Inner mandible—right side, dorsal aspect.
„ 7.—Outer „ „ „
„ 8.—6 × 7 shown *in situ*.

On the Macrotrachelous Callidinæ.

By David Bryce.

(Read 15th January, 1892.)

Plate II.

I propose to put before you this evening a few remarks upon certain Bdelloid Rotifers, which I term the *Macrotrachelous Callidinæ*, and to conclude with brief descriptions of four new species.

The genus *Callidina* comprises, as is well known, those Rotifers of the *Philodinadæ* which possess no eyes, and is represented in the great Rotifer text-book by 10 admitted species, while seven others are referred to as doubtful or imperfectly described forms. For three of these last I claim readmission. The *Callidina constricta* of Dujardin is perhaps not satisfactorily described by the French Naturalist, but Mr. Milne has published a very thorough description of a form which he identifies with it, and he states expressly that Dujardin's figure is a very successful one. Indeed, if the species be not admitted on the original description, it must be on that of Milne, and so, too, must *C. musculosa*, as both species are of frequent occurrence, and easily identified from the characters given. As to the third form, *Callidina tridens*, I have not yet succeeded in identifying it, but I am not disposed on that account to consider doubtful a species so fully described by an observer who has given special attention to the genus. One other species of Mr. Milne's, *C. reclusa*, was described too late to be mentioned in the Supplement. These bring the total up to 14 species, and a fifteenth was recently brought before you by Mr. Parsons. If you further add the four species which I shall presently introduce to you, and still two others which will shortly be described by Mr. Percy Thompson, you will find that the humble and usually overlooked genus *Callidina* numbers no less than 21 species, of which at least 19 occur in this country. It has thus a certain numerical importance, but I

desire to show you that it is important from a higher point of view, viz., that the habits and life histories of various species present to us some very interesting biological studies, peculiar so far as is yet known to this one genus.

But which are the *Macrotrachelous Callidinæ?* On page 59 of the Supplement Dr. Hudson tells us that Milne proposes the genus *Macrotrachela* for three-toed *Philodinadæ*, having the pre-intestinal part of the body decidedly longer than the post-anal, and that all the species are *Callidinæ*. When this was written Dr. Hudson had probably not seen Mr. Milne's second article (No. 187 of the "Bibliography"), for in it was described a species, *Macrotrachela Roeperi*, very similar in habits and general structure to *Callidina reclusa*, but possessing two distinct eyes within the frontal column, and, therefore, technically not a *Callidina*. In this article, and *apropos* of these closely related species, Mr. Milne again urged the proposition made originally as regards the species now known as *Adineta oculata*, that Ehrenberg's classification of the *Philodinadæ* was unsatisfactory, insomuch as it associated species manifestly distant, while separating species as manifestly of a close relationship. To amend the position he proposed in his earlier paper a new arrangement of the genera, and among other suggestions brought forward the new genus *Macrotrachela*. To my mind this genus associates a very compact group of species, with a decided family likeness, and I should much like to adopt it, and to see it accepted, but the scheme involves the primary separation of the *Philodinadæ* into those having four toes and those having three toes, a character extremely difficult to detect, and, therefore, a bad one for such a purpose. Without going further into this matter, I have ventured, by the use of the term *Macrotrachelous*, to avail myself of the most valuable of Mr. Milne's suggestions, to denote those *Callidinæ* in which, when fully extended, the post-anal portion is decidedly shorter than the pre-intestinal.

Three species, *parasitica*, *socialis*, and *magnicalcarata*, do not possess this character, and these, therefore, do not fall within my subject matter. They have, however, one common point of interest, namely, that all three are ecto-parasitic upon other forms of animal life.

The remaining species are all *Macrotrachelous*. Their great

peculiarity is that by far the majority of them seem to have their habitat among, or upon, the stems, leaves, or bracts of various mosses. Specimens are rarely found in ordinary dippings, nor are they met with crawling over the leaves of the usually gathered water plants, and this is doubtless the reason why so little has been known about them. My own method of collection is both successful and very simple. Provided with several wide-mouthed bottles, with tightly fitting corks, I gather (with as little soil as possible) threads or stems of moss from old walls, from damp banks, from the bark of trees, from alongside pools, or, best of all, from tufts of *Sphagnum*. I take care not to pack the moss tightly, nor do I add water, for the moisture clinging about the moss is sufficient (in a well-corked bottle) to keep the *Callidinæ* alive for months, I presume in a succession of generations. This refers to moss gathered in a moist state, but if gathered from dry positions it may be slightly damped, no more. The store bottles (for which may be substituted tin canisters) should be kept in a cool room, and exposed to nothing stronger than a north light. When convenient I place a stem or two in a zoophyte trough, and add water. After a few minutes I move the moss briskly to and fro in the water, and then remove it. I place the trough in an inclined position, and when the water is sufficiently clear I remove it to the inclined stage of my microscope. A brief search with the one-inch power generally reveals specimens of several species of these *Callidinæ*, accompanied by *Adineta vaga*, and several species of the *Cathypnadæ*.

I have not succeeded in locating any favourite lurking place of the apparently free-living species about the moss stems, but the forms *symbiotica* and *Leitgebii* are stated to make their home in certain cavities and corners formed on the under side of the leaves of four species of *Jungermanniæ*, and Dr. Hudson, in a very interesting passage, relates to us how, after reading Dr. Zelinka's account of their habit of life, he remembered where he had noticed some moss of one of these species, and having brought some home was delighted to find some of these *Callidinæ* inhabiting it in the manner described.* These two forms, *symbiotica* and *Leitgebii*, have a special interest. They appear to

* I have to thank Dr. Carl Zelinka for a copy of his instructive paper which he most kindly forwarded to me.

be constantly associated with these four species of moss, occurring in specimens gathered in the most remote districts of Germany and Austria, and at least in one case in England. But, further, this constant association has suggested that there is a certain benefit accruing to the moss-plants from their affording house-room to these *Callidinæ*, and that there is here a true case of symbiosis. We have, in other Rotifera, instances of both the complete and the partial parasitism. To use everyday language, some species are "full boarders," others are only "lodgers," yet neither class gives any return for benefits received. In *Callidina symbiotica* and *C. Leitgebii* we have, I think, the first species of Rotifera whose association with another organism has been supposed to be mutually advantageous.

There is no suggestion of symbiosis made with respect to *Callidina reclusa*, but its life-history is quite as remarkable. I may be allowed to bracket with it for the present purpose the species *Roeperi*, already mentioned, as having a similar habit of life. These two species live in the cells forming the outer layer of the stems of the small side shoots of *Sphagnum*. If you place under your microscope such a stem from which you have stripped the leaves you will see that this outer layer consists of elongate cells of some little size, and that many of them possess, usually at one extremity, an opening whose margin is sometimes rather elevated, and through which water may freely enter into the cell cavity. These peculiar cells are found by these Rotifers to be exceedingly convenient. There is sufficient space inside to allow them to turn about, and there is a suitable opening from which to protrude their heads when they are hungry, and desire to gather food supplies by the action of their trochal discs. They are protected both from sudden drought and from the attacks of roving enemies. They lay their eggs in the cells, and, indeed, it is probable that under ordinary conditions they rarely quit a cell in which they have once established themselves. They are to be found in nearly every piece of freshly gathered *Sphagnum* which may be examined, and I have succeeded in keeping a colony alive in captivity for some little time.

As far as I have yet seen, none of the other forms known to me can be said to prefer any one kind of moss to the exclusion

of others, but there is doubtless much to be learned yet both about this and the supposed symbiotic relations to which I have referred.

The form described by Mr. Milne as the *Callidina elegans* of Ehrenberg, and which I believe to be quite distinct from the species described by Mr. Gosse under the same name, is by no means uncommon. It usually appears in the trough as a restless wanderer, and will crawl about for hours without protruding its wheels. On one occasion I found a colony established in one of my jars, and I discovered that it had the habit of gathering around it, by the continued action of the wheels, a small heap of dirty floccose matter, similar to that made by *Rotifer macroceros*, but with this difference, that whereas the latter Rotifer usually perches upon a conferva thread or in the axil of some leaf, the *Callidina* appeared, in the absence of such convenient spots, to have simply gathered its little pile wherever it might happen to be. I found the little houses lying free among the sediment.

Mr. Milne has recorded some similar tube-dwelling specimens, but does not appear to have made out the species, and I am in the same position with regard to another series of individuals, which were neither the above-mentioned *C. elegans* nor any other of the forms familiar to me.

I have frequently kept specimens of both *constricta* and *quadricornifera* for many days in a trough, and have never observed in either the least approach to this tube-making habit. On the contrary, without being wild, they, and also *musculosa*, *lata*, and *plicata*, do not care to remain long at one spot. They readily protrude their wheels, and will continue feeding for some time, but presently, for some apparent reason, they withdraw their coronæ and march, caterpillar fashion, a very little way, and again commence feeding, and so on. Whether it be that they thus endeavour to avoid the accumulation of refuse about them, or that they find that they are attracting the same rejected particles over and over again; whether they are timid, or perhaps sensitive to the unaccustomed glare of light, I cannot say, but such is their behaviour when under observation. These five species are all moderately common and easily studied.

There are only two species which swim readily—these are

musculosa and a form which I take, but with great doubt, to be the *bihamata* of Gosse. Each has its own peculiar attitude and movement.

The other species confine themselves to crawling, mostly after the caterpillar fashion, common to the *Philodinadæ*, yet some with a peculiar modification of it noticed both by Gosse and Milne. It is a peculiar mixture of gliding and creeping, and it has been suggested to me that the usual movement of *Adineta* is of the same character. The effect is indeed the same, but it is produced by very different means. In *Adineta* the corona has been modified into a mere furring of a ventrally placed portion of the head, and the gliding motion is due to the action of the cilia which form the furring of this prone face. In these *Callidinæ* the corona is completely retracted during the progression, and the motion is due to a number of strong cilia which protrude from the hollow tip of the frontal column when fully extended, as in crawling. Thus, so soon as the toes leave hold of the glass, these cilia, by their action on the opposing surface, drive the Rotifer forward until the toes can again fasten themselves. The species in which the cilia of the column are so powerful as to produce this gliding movement, possess therein a method of progression distinct from that of any other Rotifers known, in arising from the action of cilia which have no connection either with the corona or with the buccal orifice.

Another curious peculiarity of some of these forms is their treatment of the food particles after these have passed beyond the mastax. In *constricta* and some others the food is then formed into small pellets, suggestive of those seen in *Paramecium*, but probably moulded in an œsophagus; and the capacious stomach presents a very peculiar appearance when filled with these pellets. An alternate heaving motion provides the necessary agitation of the food. In other species the alimentary canal can be more readily seen to be a long tube in which the food, not moulded into pellets, is agitated by powerful cilia. In some cases I have not been able to detect the presence of cilia at all.

It would be unfitting to attempt here even a brief description of the structure of one of these *Callidinæ*, but as I should wish these notes to have more than a passing interest, I will very shortly indicate some points to which a student should pay par-

ticular heed, and I can predict that he will be astonished at the well-marked individualities which he will find to exist.

Commencing with the trochal discs, he should note their breadth, relative distance, height from secondary wreath, and proportion to breadth of head; the positions in swimming, feeding, crawling, partial retraction, and complete retraction; the shape of the rami, and the number of teeth on each, taking care that he does not mistake fine teeth for the fine striæ frequently present; the structure of the frontal column and the membranous shielding flap with which the tip is provided, and which might be mistaken for two hooks; the antenna, its length and direction; the skin, its folds, surface, and pseudo-armature. The foot should be considered as including only the post-anal segments. The spurs, though usually short, are very distinctive, and the toes very difficult to see at all, far less define and count. The treatment of the food and the various movements assisting the digestive action should be watched while the animal is feeding. Above all, sketches should be made and copious notes taken at every opportunity.

Before mentioning the characters of the four new species I wish to say that I have not been able to identify, to my own satisfaction, any of the *Callidinæ* described by Mr. Gosse, and that if anyone here can furnish me either with specimens or with further particulars of these species he will confer upon me a very great favour.

Callidina plicata, n. sp.

Sp. Ch.—Elongate and without medial swelling when crawling. Central portion of trunk with coarse dorsal and lateral skinfolds, mostly extending forward over anterior portion and the central dorsal pair extending over posterior segment, the latter, conspicuously swollen and hood-like, constricted at upper and near lower end. Foot only displayed when crawling. Spurs moderately stout and short cones, with slightly produced points, showing (rarely) narrow interstice when at greatest separation. Wheels rather large; mastax ample, rondo ovate, two teeth on each ramus.

Intestinal action a periodic heaving, food not moulded into pellets.

It is possible that the hood-like segment, apparently consist-

ing of one joint, is, in reality, a modification of the two ultimate trunk joints.

Length—Extended about $\frac{1}{80}$ inch.

Habitat—Among *Sphagnum* and other mosses. Epping Forest and Isle of Wight. Common.

Callidina lata, n. sp.

Sp. Ch.—Very short and broad, central portion of trunk much flattened, broadest behind the middle, suddenly narrowing to posterior segment. Dorsal skinfolds obsolete, lateral very deep. When feeding posterior trunk segment about one-third width of central portion. Foot slender, spurs slender, acute and of moderate length without interstice. Wheels rather small, about width of head. Food moulded into coarse pellets. Mastax pyriform, three teeth on each ramus. Column furnished with rather long cilia.

The peculiar breadth and squareness of the central portion of the trunk is usually apparent even in crawling. Occasionally, however, a specimen will present, for a moment, the facies of a *Philodina*. In complete retraction it assumes the form of a broad ellipse whose greatest length is transverse to the body axis. A rather small form, yet varying much in size, large specimens about $\frac{1}{125}$ inch when extended. It crawls rather slowly, yet with a slight gliding motion as described above. I have thought that I could detect a few setæ at tip of column as well as the usual cilia.

Habitat—Among *Sphagnum* and other mosses. Epping Forest, Folkestone, and Isle of Wight. Scarcely so common as the last.

Callidina spinosa, n. sp.

Sp. Ch.—Longitudinal skinfolds and those marking trunk segments armed with very short prickle-like points set closely together, the angles marked with rather longer points. A short spine on centre of ventral margin and a longer one at each lateral angle of anterior edge of first trunk segment, Spurs rather long and of peculiar shape, at first parallel, they are bent outwards at a right angle and thence incurved, so that each describes a $\frac{1}{4}$ circle, the points being directed downwards and backwards.

I only found one specimen of this peculiar form; it was ex-

ceedingly timid and would scarcely extend itself, far less commence feeding. The cuticle was dense, and I could not get at internal details, nor could I count with certainty the number of teeth on each ramus. When extended it had rather the outline of a *Philodina*, but I could not detect any eyes. As the head and neck were protruded the lateral spines became depressed, falling close to the sides. The spurs have a distinct resemblance to the toes of *Taphrocampa selenura*, and were each nearly $\frac{1}{1300}$ of an inch in length, that of the whole animal extended being estimated at about $\frac{1}{140}$ of an inch.

Habitat—Among *Sphagnum* from Sandown, Isle of Wight.

Callidina aspera, n. sp.

Sp. Ch.—Longitudinal folds of trunk, both dorsal and ventral, beset with closely set blunt points. Mastax rondo-ovate with two teeth on each ramus. Spurs small cones, just longer than thickness at base. Of a brownish colour. Wheels rather small, scarcely wider than head.

Several specimens found among Hypnum given to me by Mr. Thompson, and gathered by him in Epping Forest.

Length about $\frac{1}{125}$ inch extended.

Habitat—As above.

Description of Plate II.

Fig. 1.—*Callidina plicata*, wheels protruded, dorsal view.
1*a*. Foot extended as in crawling, lateral view.
1*b*. Ditto, ditto, dorsal view.

" 2.—*Callidina lata*, wheels protruded, dorsal view.

" 3.—*Callidina spinosa*, retracted, ventral view. 3*a*. Spurs.

" 4.—*Callidina aspera*, wheels protruded, dorsal view.

Chantransia trifila: a New Marine Alga.

By T. H. Buffham, A.L.S.

(Read Feb. 19, 1892.)

Plate III.

The genus *Chantransia* includes some species which live only in fresh water, while others are found in the sea. Those marine species known in Harvey's time as British were in the *Phycologia Britannica* included by him in *Callithamnion* as he considered they bore tetraspores. This, however, is now known to have been a mistaken observation, as their neutral organs are undivided, *i.e.*, they are monospores. Until recently the antheridia and cystocarps were known in only two species, one fresh water: *Ch. investiens* Lenorm.; the other marine: *Ch. corymbifera* Thur. Mr. G. Murray, F.L.S., and Miss Ethel S. Barton have, however, described and figured all three kinds of reproductive organs in a new British fresh water species—*Ch. Boweri* discovered by Mr. Murray and Prof. Bower in Scotland in April, 1890. For a full account of this species and of the present position of this genus, which has had a remarkable history, the student should refer to the paper by the authors just named ("On the Structure and Systematic Position of *Chantransia*" in *Jour. Linnean Soc.*, Vol. xxviii, p. 209). I need only remind you that all the marine species are epiphytic minute, generally even microscopic; while the sexual organs are of the simplest character known in the *Florideæ*.

The plant I have to describe was found (Aug. 1890) epiphytic on an old piece of *Cladophora* (? *utriculosa* Kütz.) which, fortunately for the study of the *Chantransia*, had discharged nearly all its green contents in the form of zoospores. As there were several hundreds of specimens of the *Chantransia* there was ample material for learning the true characters of the epiphyte in all stages of the neutral or monosporiferous state, there being no sexual organs found.

I regard the mature plant as that condition in which monosporangia are borne, for within very narrow limits the fertile plants may be described as almost precisely alike. When in this condition the plant starts with a basal cell, undivided, by which it is attached to the host plant. This cell is nearly spherical, oblate, about 6 μ in horizontal, and 5 μ in vertical, diameter. From it arise three filaments: the right and left ones slightly incurved, each consisting of three or four cells, all but the apical one being about 5 or 6 μ long, and nearly as thick, but the apical cell is frequently conical, 3·5 μ thick at base, and prolonged into an excessively fine hair, at times as long as the four-celled principal filament itself. Between the lateral filaments arises vertically the third filament, of nearly similar character and dimensions, so that all three filaments lie in the same plane. The monosporangia are terminal on one- or two-celled branches, generally on the inner side of the lateral filaments. These branches are as a rule parallel with the middle vertical filament. The monospore is spherical, 7-8 μ diam., and is discharged from the sporangium at its apex. There are rarely more than two on a plant at the same time. The middle filament is seldom branched, and its branches rarely fertile. I have observed no clear case of a fertile plant without these three primary filaments, and I have never observed more than three. The vertical height of the mature plant—not including the terminal hairs—is 27-30 μ (·0011-12 inch). Thus it must be the smallest Floridean known, and a Microscopical Club is appropriate for its first introduction.

When the monospore is discharged its contents contract and become darker, and its lower side, in contact with the host, hyaline. A lateral cell buds out on one side, and grows into an inclined filament of two or three cells before the corresponding one appears to match it on the other side. These attain nearly their full length before the middle one begins to appear. Then a branch or two arise to bear the monosporangia. I am not aware of any parallel case where a single basal cell gives origin to three primary filaments.

The characters of this curious little plant may be summarised thus:—

Chantransia trifila n. sp.—Very minute, about 27-30 μ high. Basal cell single, being a modified monospore. From this arise

three filaments in one plane, of three or four cells in length, sometimes terminating in a very thin hair. Cells about 5 μ long, and 4-5 μ diam. Monosporangia 7-8 μ diam., spherical, terminal on 1-2-celled branches on the inner sides of lateral primary filaments. Antheridia and cystocarps unknown.

Habitat. On old *Cladophora* (? *utriculosa* Kütz.), Swanage.

Explanation of Plate III.

Chantransia trifila n. sp.

Fig. 1.—A fully mature plant with three monosporangia, one of which is empty. × 200.

,, 2.—Mature plant with two monosporangia. × 1000.

,, 3.—Empty monosporangium. × 1000.

,, 4.—Very early stage: the basal cell and one lateral filament of three cells. × 1000.

Conjugation of Diatom: Orthoneis binotata Grunow.

By T. H. Buffham, A.L.S.

(Read Feb. 19, 1892.)

Plate III.

The valve of this marine diatom is elliptical, axes of the ellipse as 4 : 3, with a median raphe, central and terminal nodules, and a more or less indistinct stauros. The transverse rows of dots are straight near the centre of the valve, and curved as they approach the extremities, about 40 in ·001 inch (=16 in ·01 mm.). These cover the whole of the outer surface of the valve. Viewed from the inner side there is seen to project from each lateral edge of the valve a semi-elliptical plate which reaches about half way towards the raphe. The plate has a length of about half that of the valve, and one-fourth that of its breadth. Although a prominent feature in every view of valve or frustule its structure is not easy to define. It appears, however, to be irregularly nodulose, and thicker and much less translucent than the valve (Fig. 5). Having seen a valve with both plates broken off, but yet with very little of the edges of the valve deficient, and after carefully focussing on the perfect valve, I confidently offer Fig. 6 as a representation of an ideal transverse section of the valve.

It is, however, the living plant that is more interesting. I cannot learn that it has been observed in this country in this state, nor are there any figures extant. I first saw it adhering to a small specimen of *Ceramium græcillimum* Griff. et Harv. collected at Brighton in Sept. 1884, but the diatoms were not numerous. Since then I have observed it not infrequently in small numbers on filamentous algæ, usually on the older portions. But at Swanage in Aug. 1890 it was growing on *Calothrix conforvicola* Ag. in sufficient quantity and in a state of conjugation so as to permit of more extended study.

The frustule is contained in a hyaline, gelatinous mass, of symmetrical figure. Viewed laterally (*i.e.*, what is usually

known as the "front view" of the frustule) it appears as a half or three-fourths of a sphere, its base resting on the host (Fig. 10). When seen from a point vertical to the base the gelatinous investment has an elliptical outline of similar proportions to that of the frustule. But from the extremities of the minor axis there are mammiform protuberances through which pass long processes of the same substance: these we might call *tentaculoids* (Fig. 9). And to avoid circumlocution I venture to propose for the gelatinous investment of this and some other diatoms the term *periglœa.*

The frustules vary in size from 42 by 30 μ to 23 by 18 μ. The periglœa exceeds the dimensions of the frustule by about half in length and breadth. Each tentaculoid, however, sometimes reaches a length of 320 μ (·0126 inch) while the diameter near the mammiform part surrounding its base is 6 μ, and near its apex 2 μ. Moreover their origin can be traced to those parts of the frustule where the plates above described lie in apposition (Figs. 9, 10).

With regard to the ordinary mode of multiplication by division of the frustule when the stage shown in Fig. 10 is reached I am inclined to the view that both frustules are discharged from the periglœa, for this is so uniformly perfect in outline that no signs of a rupture are visible, although, on the other hand, it is rare to see a valve completely free from any periglœa. A very early stage is drawn in Fig. 7. Later on the swellings through which the tentaculoids are projected are prominent while the tentaculoids themselves are as yet only short and thin (Fig. 8).

We now come to the mode of conjugation. As in other diatoms only the smallest individuals are concerned in this process. A frustule which has completed, or almost reached, the stage of self-division (as in Fig. 10), and is only 23 μ long, has a bulbous addition to the upper part of its periglœa, into which the double frustule rises. This speedily enlarges into a perfectly spherical sporangium of 75 μ diam. The frustules occupy the centre of this, and then the lower one imparts its endochrome to the upper one. This upper frustule then divides and forms two masses of endochrome which develop into two sporangial frustules of exactly double the length and width of the parent. One valve of the mother-frustule is closely

applied to the upper side of the upper sporangial frustule, and the other valve to the lower side of the lower frustule. The old lower frustule—which, perhaps, we must not call the male —is usually seen as two clean valves slightly separated and lying nearly vertically to its old position (Fig. 11). Now in this case the original periglœa, although deformed, remains at the base of the sporangium, and the tentaculoids can still be seen.

The process of conjugation just described would fall under Smith's I. class (*Brit. Diatomaceæ*, Vol. ii, Introd., p. xii) in which "we have two parent frustules and two sporangia [*i.e.*, sporangial frustules] as the result of their conjugation."

The new valves are exactly like the normal ones in siliceous firmness and in other characteristics. As they are 46 μ long, and vegetative frustules have been measured to 42 μ in length, there is no doubt that the sporangial frustules issue from the sporangium (which may be seen empty and deformed) and assume a periglœa and multiply in the way normal to diatoms.

This diatom seems to have only one British record, and that is only of the valve. Roper published this in 1858 as *Cocconeis scutellum* Ehr., var. γ (*Quarterly Journ. of Microscopical Science*, Vol. vi, 1858, p. 24, Pl. iii, Fig. 9). He found this in one gathering at Lyme Regis, and it is clear that he had not observed the frustules *in situ*. In 1863 Grunow regarded it as a distinct species and it became *C. binotata*, Roper's valve being var. *stauroneiformis*. (*Verhandlungen der zoologisch-botanischen Gesellschaft in Wien*, Band xiii, p. 145, Tab. iv, Figs. 13, 14). The same author in 1877 describes the valve as differing from *Cocconeis*, and says "two long horns (in the living frustule) project from it at the places where the semi-circular plates are situated," and he regards these "horns" as distinguishing *Orthoneis* from *Mastogloia* (*Monthly Microscopical Journ.*, Vol. xviii, p. 177). The mode of conjugation described now would certainly distinguish it from *Cocconeis*. Smith places the last named genus in his III. class where a single frustule produces a single sporangium [=sporangial frustule]. (*Loc. cit.* p. xii, Pl. B.)

It seems clear then that the plates have some physiological value. Whether the tentaculoids are of any assistance to the organism in its "struggle for existence" is not evident to me, and I have no suggestion of any value to make.

I submitted specimens of *Orthoneis binotata in situ* to several diatomists of wide experience, who, however, had never seen it. I have pleasure in acknowledging my indebtedness to Mr. Thos. Comber, F.L.S., who, following a slight clue, tracked it down to the authorities I have thus, through his kind assistance, been enabled to quote.

I may be permitted to add here a short note on conjugation of *Rhabdonema arcuatum* Kütz. (*Journ. Quek. Mic. Club*, Vol. ii, Ser. ii, p. 131.) In a gathering sent me by Mr. W. H. Shrubsole, of Sheerness, in Jan. 1889 I found all my former conclusions amply confirmed. But—what was more interesting—I noted at the same time three small specimens of *Rh. minutum* Kütz. only 18 μ wide (=·0007 inch). All of them had the small frustules attached laterally, which in *Rh. arcuatum* I considered males;* and two of the specimens bore *single* sporangia. These, *pro tanto*, confirm my former results, and show that the phenomena are generic.

Explanation of Plate III.

Orthoneis binotata Grunow.

Fig. 5.—Inner side of valve with plates projecting from the edges. × 800.

" 6.—Ideal transverse section of the same. × 800.

" 7.—A frustule in very early stage of periglœa (girdle or zonal view). × 400.

" 8.—The same more advanced. A short, thin tentaculoid passing through the mammiform protuberance. × 400.

" 9.—Vertical or valve view of mature frustule in which the tentaculoids are seen to originate from the plates. × 400.

" 10.—Girdle or zonal view of a pair of frustules, the result of self-division. × 400.

" 11.—Mature sporangium containing two sporangial frustules and the four old valves. × 400.

* In Bennett and Murray's *Cryptogamic Botany*, p. 423, I am incorrectly reported as describing the male frustules attaching themselves to any part "of the girdle" of the female frustule. The words "of the girdle" are quite contrary to my statement and should be omitted.

PRESIDENT'S ADDRESS.

By Dr. W. H. Dallinger, F.R.S., F.L.S., etc.

(Delivered March 18th, 1892.)

My duty to-night is rather the congenial one of having a pleasant half-hour of friendly communion with fellow members and fellow microscopists and workers, than the formal one of a laborious inaugural address.

It is one of the distinctive features of this Club that the element of friendliness and fellow-help runs through all its work and all its workers, giving it its special place amongst all kindred societies. It seeks the highest in its own department, but knowing that the highest theoretical and practical efficiency in the microscopist must begin in the simplest efforts, it aims at the especial encouragement and aid of those who are beginning; and, happily, this aid can be and is given, not only in the genial spirit of fellowship, but with the efficiency which is inevitable when, as in the case of this Club, some of the most experienced and practical microscopists in the country afford ready help.

If, as a club, we were not—as we certainly are—promoting the interests of optical science and research into the more hidden details of Nature, we should yet be doing a good work in inducing men, who would otherwise perhaps less wisely spend their leisure, to devote it to the intelligent understanding and employment of our favourite instrument.

Hobbies and hobby-horses have come in for much serio-comic reflection; indeed, they constitute almost a perennial theme. But after close observation of the men of my time, I have no hesitation in affirming my belief that the men with intelligent enthusiasm in reasonable hobbies constitute some of the most enlightened and thoughtful men of a generation. And, therefore, I believe that by increasing the membership of our Club we are increasing the number of better citizens and better men, as well as promoting the common scientific welfare.

To some in this hall, the time seems not to have very long passed when, in this country, almost all scientific work was *voluntary*, and, in a sense, the majority of scientific workers were amateurs. All that is changed now; happily, science as a profession is widely cultivated in all its branches, and our country possesses some very fine, efficient, and original workers. But this boon, great as it is, may be attended by a far from impossible danger, a danger that some, at least, see looming near—that is, the conclusion that now only the professional men of science are doing serious scientific work; or, still worse, the existence of a tacit assumption that sound scientific work is only to be looked for from professional sources.

From the nature of the English mind and the history of English science, the suppression of the amateur as an important factor in certain classes of English research and experiment would be, I believe, greatly to be deplored. And it may be fervently hoped that scientific work of real value will long continue to be done in this country by men who, though not professional workers, are still intelligent and ingenious investigators of Nature.

No doubt amateur work of this sort, done alone, and without the enlightenment and stimulus which comes from comparison with similar or kindred work by other workers, is not wise. The best results are not attainable in this way. A most essential thing in any department of even amateur inquiry is to know what *has* been done, is being done, or can be done. And here, again, comes out the value of a club with aims like ours. It is undoubtedly a feature of our immediate time, and an indication of the broadening interest in the microscope and microscopy, that clubs and smaller societies are being formed in so many centres.

Five and twenty years ago, when my work in microscopy began, there were many of our very large towns with no trace of a society of microscopists. But in the interval between then and now such societies have been formed, have flourished, doing frequently valuable work, and then, nominally by the exigencies of city life, have been broken up into three or four clubs or smaller societies in suburban parts, leaving the parent society often greatly enfeebled, if enabled to exist.

Now, my experience of these societies is, that although the

intention was always a high one, that of making meeting easier, and, therefore, mutual work readier, this is by no means the inevitable consequence. There is frequently ultimate inefficiency, and, at times, a total dwindling away.

There can be small doubt, in my judgment, that all such societies, especially in a city like this, if formed at all (and there may be good reasons for forming them), should not be considered as supplanting a central society such as ours.

Even with men of science and microscopists there is a sense in which there is "power in numbers," but beyond this there is influence in persons. Men, known and distinguished, whether as professionals or amateurs, always exert upon younger and aspirant minds an influence, while the *esprit de cœur* is not without its effect; and the larger communion and larger opportunity for the comparison of work is always powerful. Without doubt, it would promote the largest and best interests of amateur microscopy, in both London and the great provincial cities, if the sectional club in the suburbs, conducted with great economy, was normally considered an appendix to, and not a supplanter of, the original and central society.

In the position I occupy to-night, it is, of course, easy to go hastily over the work which has been done by the Club during the year. But I doubt if this is complimentary, either to the work done or to you, who have already received and discussed it; it carries with it, too, the defect of all cursory glances. But I am constrained to refer to one subject to which our attention has been called during the year.

I discussed last year the merits of the remarkable new object-glass produced by the firm of Zeiss, having the great numerical aperture of 1·60 and a magnifying power indicated by 2·5 m.m. It was shown that while this glass had remarkable properties, and formed a beautiful image, yet it was inefficient:

(1.) Because it was not provided with even an achromatic condenser of equivalent angle, but was worked of necessity, if all its N.A. was utilized, with a condenser of dense flint, with both spherical and chromatic aberration absolutely uncorrected.

(2.) Since its N.A. was so great, it could only be illuminated and its image formed through homogeneous media, com-

bining glass, mounting material, and immersion fluid, all having alike a refractive index equal to this aperture.

Such a medium had been found, both for mounting the objects and immersing, both the condenser with the mounting slip and the front of the lens with the cover. But the mounting medium has proved valueless because transient. All the slides I have received from Germany have perished; none has lasted longer than five months. This is a block to a persistent attempt to discover the real merits of the object-glass. It is only by comparison under varying circumstances of a well-known object that reliable conclusions can be drawn.

If, therefore, after laborious work such a slide has been examined and its special points "logged" and carefully noted, it is more than discouraging to find it, as a mounting, wholly destroyed by a kind of disintegration in a few months. But even such a slide could only be a mount of silicious or calcareous bodies, such as diatoms, spicules, foraminifera, and so forth. Animal or vegetable tissues, or minute organic forms, as I pointed out, must be irretrievably destroyed by the only mounting media which could be employed.

I expressed a hope that ultimately some medium, tolerant, at least, of dead organic forms and animal and vegetable tissues, might be discovered. It is not to-night, however, my good fortune to report its discovery. But, happily, we are never at a standstill. For some time we have been striving to obtain a thoroughly monochromatic light for microscopical purposes. With much confidence ammonia-sulphate of copper solution was used, and various batches of blue glass, made both in England and on the Continent. But when critically examined they were found not to be monochromatic at all. We all know that Hartnack constructed an arrangement of prisms, afterwards made by Zeiss, for screwing on to the under side of the stage, and throwing a not very widely dispersed spectrum on to the image on the stage.

The defect of this was its feebleness. It could not be used with a condenser; in fact, was made before the Continental makers had yet perceived that the condenser was a vital and practical part of the optical action of a microscope.

Clearly, therefore, no critical image with a lens of large N.A. and considerable power could be produced by this means;

and its value as a monochromatic illuminator was not considerable.

Yet it has for some long time been clearly seen that the advantages of true monochromatic light were great for special purposes. It was made popularly manifest in detail by the publication of Mr. Crisp's valuable "Aperture Table."

Thus, for example, it is readily discoverable by it that while a lens of N.A. 1·40 will, by calculation, in white light (line E.) resolve 134,974 lines to the inch, the same lens employed with pure monochromatic blue light (line F.) will resolve 146,305, that is to say, will show to the skilled observer 11,331 more lines to the inch.

Again, an object glass having a numerical angle of 1·52 will, in white light, reveal 146,543 lines to an inch; but if illuminated by pure monochromatic light, the same lens will reveal 158,845 lines to the inch, so that monochromatic light in this case gives us an added power of 12,302 lines to the inch.

Now by the hypothesis of diffraction spectra, as explanatory of microscopic vision, that means, what in reality it is, a practical increase of numerical aperture.

But more, true monochromatic light really almost changes an achromatic lens into an apochromatic one; but the great difficulty has been hitherto how to produce monochromatic light which should be absolutely such, and yet be within the reach of all, and under control as to its measure of intensity when employed with high powers, so as to enable the worker to employ a suitable corrected condenser.

Sunlight is undoubtedly the purest and finest source, but we so rarely have the privilege of seeing and using it that, if we could obtain it from limelight, or still better, from strong lamp-light, it would be a universal boon.

Now, during the year Mr. Nelson has devised a very simple and thoroughly practical piece of apparatus for obtaining a good spectrum with either lamp-light or oxycalcium illumination, which allows the condenser to be used with every portion of the spectrum at will, and gives light enough to work easily with the violet end.

With this, beautiful results are attainable with lenses which the apochromatics had superseded; in other words it gives them a renewed value.

But, as I pointed out when Mr. Nelson introduced this simple instrument, I do not think that he claims for it what I believe will be its largest result.

As we saw last year, and have repeated to-night, we are practically, for the present, at the limit of our possibilities by mere increase of N.A.

I believe it is held by practical opticians to be possible to construct a lens with a N.A. of 2·0. But granted that the working distance could be made sufficient, the mounting media form, for the present, an insuperable difficulty.

For this reason many skilled theorists and practical microscopists are looking to the diminution of the wave-length of light in specially constructed object-glasses as a means of their further improvement. Dr. Czapski has in a comparatively recent paper dealt with this aspect of the question.*

The condenser, of course, would be inevitable, and all rays, save those from a monochrome of the spectrum, would be excluded; and these must have an intensity sufficient for all purposes. But it may be certainly stated, as Dr. Czapski shows, that by such means a lens with a N.A. of 1·40 would be practically increased to 1·75; and so on with higher apertures measured in white light when employed with the shorter wave-lengths of the violet and blue rays.†

But the special point of interest is that with object-glasses of far less N.A. in white light we can come very approximately towards 1·60 and yet employ mounting media that will not destroy, but permit of the examination of fine organic tissues.

Clearly, then, Mr. Nelson, with intelligent insight, has provided us with exactly the means we require for using with the utmost advantage our best achromatics, and for getting the greatest optical results possible from our most perfect apochromatics of large aperture.

All this, of course, applies to the higher reaches of the microscope and its work in research, and it would be a mistake indeed if these were not included in the work of a society like this.

It may be as well to note here that a solution is in use by some microscopists which, although I have not tested it, I

* "Probable Limits to the Capacity of the Microscope," p. 814, 'J.R.M.S.,' part vi., 1891. "Zeitschr. f. Wiss. Mikr.," viii., 1891, pp. 145-55.

† *Ibid.*

learn from excellent experimenters is practically monochromatic. It is easily prepared and used, and although it yields with lamp-light an orange light slightly tinged with greenish, gives, for critical purposes, some beautiful results.*

It will not, I feel assured, be inferred from the consideration I give, and from time to time have given, to the higher or highest powers of the microscope, that I am unconcerned for, or have but little interest in, the object-glasses of low and moderate power and the work to which they are applied.

The fact is, that properly used, the dry apochromatic object-glasses from an inch to a quarter of an inch in focal length leave relatively little to be desired; they are, so far as they go, optical triumphs. Not that they put a limit to my anticipation of what may be; I look beyond them, in hope, and even, as I think, in reasonable anticipation, to what is a still nearer approximation to perfection. But that must be when physics and chemistry have opened up new resources to the optician. It is impossible to anticipate what may be discovered for us by the steady and persistent search of science into nature. That new resources will present themselves to the electrician or the photographer, we do not hesitate to believe. All recent history makes the conclusion inevitable. I know of no reason why, in like manner, some new possibility should not open itself to practical optics. I see as much possibility of optical advance in the future as in the past.

Meantime, however, the workers with low and moderate powers of the finest construction (and they are now produced at such moderate prices as to be fairly within the reach of most) may well congratulate themselves on their possessions, and work with a zest which their instruments certainly justify.

Not only are the lenses good, but the optical appliances for employment with them are equally admirable.

We have passed the period when it was believed that all low power and moderate lenses might be used without condensers. Every compound lens is caused to do its best work with an achromatic condenser adapted to its N.A. and its focal length, and happily to-day these are accessible to all workers.

* The solution is prepared as follows, viz.:—Sulphate of copper, 2ozs. 1½drs.; bichromate of potash, 1dr. 2scrup.; sulphuric acid, 12min.; water, 6½ozs.

And when we remember what immense areas of research accessible to low power workers remains ready and waiting to be done, truly there need be no Alexander-like weeping for more worlds to conquer.

In this society we have yearly evidence of this, as, for example, in the Fresh Water Algæ, the Rotifers, the Oribatidæ and Acarina generally, and in other subjects.

But even in microscopy there is, unfortunately, a *fashion*—a tendency to a merely curious repetition of the work of others —not so much it may be with a scientific purpose as by the mere result of attraction by the newness of the objects. This was true of tissue cutting and staining, especially of differential staining.

It is true of the mere mounting and staining of Bacteria and many other matters. Not that I would, to such a group of workers as this Club represents, suggest a reflection by this; it is simply recalled by the fact of the beautiful work done in our very midst, and by one of our past Presidents, on so common an object as the Blowfly. There are hundreds of similar "common objects" awaiting work with solid persistence and moderate powers, which many of us could really do in our leisure, and by such work could enrich ourselves and benefit the world.

As a single illustration, may I suggest the Spider? True, a great deal of beautiful work has been done concerning the anatomy of spiders, and their classification has been much considered. No doubt, however, much remains to be done, even here. But it is the work and habits of this group that has been so comparatively neglected.

Some really beautiful work has been done, even in the microscopic investigation of this subject in regard to Epëira, within the last few years.

But this makes even more suggestive the possibilities of work undertaken on this group. And I can speak the more confidently because for the last five or six years my summer vacations have been spent in their study; not so much with the hope of working out new facts as of fully familiarizing myself practically with the old and the more recently investigated. My time would admit of no more; but I am convinced of the delightful possibilities of the subject to a naturalist and a

microscopist of resource and resolution. There is still one subject on which I would fain be permitted to offer, for what it may be worth, a suggestion.

I am afraid that the very word "influenza" has become so repugnant to us all that almost the sight or sound of it becomes a metaphorical "breach of the peace." None the less we all desire to see it mastered. There is an almost universal conviction amongst the faculty that it will ultimately be found to take its origin in some one or more forms of pathogenic Bacteria.

Between the search for such a form as a cause of a specific disease and the working out of the life-history of saprophytic organisms there is a wide interspace. Hospitals and hospital laboratories are alone the places in which the former work can be done, and it should, nay must, combine the knowledge of the pathologist and physician with the skill and manipulative ability of a microscopist of patience and resolution.

Moreover, it is now well and clearly recognized that the discovery of even an unusual form of bacillus or bacterium in the secretions of a patient, living or dead, is by no means a reason for announcing the discovery of the *cause* of a specific disease.

Now my investigations into the nature and characteristics of bacteria were commenced before certain forms were demonstrated to be specific viruses, before the nature of the pathogenic bacteria was fully demonstrated. Moreover, this was, in my case, only a lateral study to that of the monad group known as Saprophytes; hence, while some of my work led me, as it were, to the very edge of pathological inquiry, I was obliged to leave it there, having neither special medical training nor proper opportunity for its further pursuit on the pathogenic side.

But I am deeply interested in all researches of this nature, and have followed with some care most of the efforts made to endeavour to trace the origin of influenza to bacterial forms.

What has struck me in following the work done in this direction is the great variety of organic bodies, not only of the usual bacterial order, but from the observations of some specialists even what appear to be saprophytic forms have been found in the blood of patients.

Thus Prof. Klebs, of Zurich,* gives the results of his examination of several distinct cases of influenza, and finds in the blood of the patients a large number of highly refractile, mobile bodies, in size, form, and modes of motion resembling bodies which he has met with in pernicious anæmia, though in greatly reduced numbers.

This was found to be the case in an instance of fatal influenza, in blood "removed with every precaution" from the heart of the subject; the "monads"—for such he calls them—were easily seen and demonstrated in this. They varied in size, were oval in shape, and not only possessed a vibratory movement, but were capable of distinct locomotion.

It is significant that they were often attached to the margin or imbedded in the substance of the blood-corpuscles.

They were distinctly flagellated, and certainly recall to us the form and manner of saprophytic forms.

Prof. V. Babes very carefully investigated thirty-one cases of influenza with all the skill for which he is celebrated. He endeavoured to show that there exists a series of bacteria which, in their growth and shape, are approximate to, or identical with, Pasteur's sputum bacteria on the one hand, and on the other to *Streptococcus pyogenes*.†

Herr. I. Prior examined fifty-three cases of influenza.‡ Twenty-nine of these were without complications. His researches also showed the constant presence of *Streptococcus pyogenes*, and also *Staphylococcus pyogenes aureus;* these were present in all secretions.

In the same way Herr E. Levy§ found that on examining eighteen cases of influenza the *Diplococcus pneumoniæ* was present in seventeen of these, while occasionally he found also *Streptococcus pyogenes* and *Staphylococcus pyogenes albus.*

Again, Kowalski|| examined sixteen cases of influenza, and isolated three kinds of micro-organisms which he believed to

* "English Mechanic," p. 525, 1890.

† "Centralbl. f. Bakteriol. u. Parasiteuk," vii. (1890), pp. 460-4, 496-502, 533-8, 561-8, 598-606.

‡ "Munchener Med. Wochenschr.," 1890, Nos. 13-15. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk," vii. (1890), pp. 705-7.

§ "Berlin Klin. Wochenschr.," 1890, No. 7. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk," vii. (1890), pp. 701-3.

|| "Wiener Klin. Wochenschr.," 1890, Nos. 13 and 14. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk," vii. (1890), pp. 701-3.

be unknown. The first resembled the typhoid bacillus; the second variety formed snow-white colonies on the surface of the gelatin, which was liquefied; the third kind grew best in agar, at incubation low temperatures, and in twenty-four hours appeared as colourless drops.

Besides these he was able to isolate *Staphylococcus pyogenes aureus*, also *albus*, and *citreus*, *Diplococcus pneumoniæ*, *Streptococcus pyogenes*, *Staphylococcus cereus*, also *albus* and *flavus*, all of which were found in the secretions of the same group of cases.

Dr. Marmerek examined the bronchial secretion of eight well-marked influenza cases,* and in seven of these found abundance of organisms which could only be considered *Diplococcus pneumoniæ*. In six cases there developed on agar plates, colonies about the size of poppy seeds, of irregular shape, of great firmness, of a blackish brown colour, and with indented outline. These cocci formed chains of from two to forty individuals.

Herr Bein examined twenty cases of influenza,† and found *Diplococci*, *Streptococci*, and *Staphylococci* in every instance. His conclusion is one of some importance, for, first, he does not regard the diplococcus, which he invariably found as being strictly *Diplococcus pneumoniæ*; and, second, he concludes that the disease is due to the co-operation of several different kinds of micro-organism, no specific microbe being, in his judgment, discoverable.

In the same manner Sig. S. Sirena,‡ in numerous similar examinations, found what appeared to be *Diplococcus pneumoniæ*, together with numerous other micro-organisms, and infers that there is no specific contagium discoverable.

Dr. Bouchard,§ after careful examination, found in the influenza cases he investigated three pathogenic microbes, accompanying every case, and pertinently remarks that two of these "are too many, if we go for a specific virus of influenza."

* "Wiener Klin. Wochenschr.," 1890, Nos. 8 and 9. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk.," vii. (1890), pp. 509-10.

† "Zeitschr. f. Klin. Medicin.," xvii. (1890), No. 6. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk.," ix. (1891), pp. 171-2.

‡ "La Rèforma Med.," vi. (1890), p. 680. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk.," ix. (1891), pp. 174-5.

§ La Semaine Méd.," 1890, No. 5. *Vide* "Centralbl. f. Bakteriol. u. Parasiteuk.," vii. (1890), pp. 375-6.

So Dr. T. Prudden,* after very close investigation of seven cases of strongly pronounced influenza, discovered *Staphylococcus pyogenes aureus*, *Streptococcus pyogenes*, and *Diplococcus pneumoniæ*, and, as a result, concludes that "bacteriology has brought to light no living germ which there is reason to believe has anything to do with causing the disease."

It thus becomes fairly manifest that a remarkable variety of pathogenic forms have been discovered by a great variety of careful workers, in widely separated localities, associated with the same specific disease.

Now mere speculation is scarcely tolerable in the treatment of a scientific question; but when we are in complete darkness on so important a subject, and are earnestly struggling to find the light, even speculation or inferential inquiry may scarcely be out of place, especially when the freedom from certain restraints, which a position like mine of to-night affords, offers itself.

It will be remembered that I have spent, and am still spending, time and effort in endeavouring to discover how far the saprophytic organisms—so closely kindred to the pathogenic microbes—are capable of being changed by continuous, gradually imposed, and prolonged changes of environment.

Some extremely interesting and suggestive results have been attained, which I am not in a position at this time even to indicate. The final results can only be obtained by persistence, patience, and years.

But I have already been able to publish some results which are, up to the point that they carry us, capable at least of suggesting further research. For in less than ten years the saprophytic organisms that are normal at a temperature 60° F. were trained to live, even with increased fecundity, at a temperature of 157° F., and yet the normal adult organisms, which had not been so trained by prolonged and cumulative change of environment, are always *killed* by immersion at a temperature of 140° F.

Now with this alteration of function no important change of form was at all visible. It was simply a modification of function.

This, and the subsequent work I have been doing, has been

* "Medical Record," Feb. 15, 1890.

convincing to me that it is physiologically and not morphologically that the saprophytes are subject to mutation, so much so that unless we take a very broad and philosophical view of what is specific, we may even appear to approach by such mutation a physiological specificity concurrently with a morphological identity with unaltered forms.

The remarkable morphological similarity of certain bacilli, whose physiological differences are terribly unlike, must strike a very casual observer.

Now I do not for a moment suggest that any case in which putrefactive forms have, by change of environment, changed their functional specificity so as to become pathogenic has ever been made out.

Nothing of the sort has been done; but what I would suggest is, that the possibility of doing this is worthy of sincere consideration and experimental research.

That certain physiological changes can be readily brought about in the saprophytes there can be no doubt. How far may these, if constantly taking place in nature, at times fill the air with minute organisms in vast clouds, which by certain altered conditions have become endowed with functional characters inimical to man and beast, taking for a time the place of common forms with which the air is usually charged, but as a rule innocuous to man and beast?

Let it be remembered I am suggesting, not affirming; inquiring, not stating.

Certainly the examination by Prof. Klebs, of Zurich, of the blood of influenza patients is more than noticeable. So far as I know distinctly monad forms are putrefactive. Klebs finds them in the blood from the heart of patients dead from influenza. More striking still, they are oval in shape, have distinct power of motility, and are found "attached to the margin or imbedded in the substance of the blood corpuscles."

This is distinctly the action of saprophytic monads. But that we are told that "every precaution to avoid contamination" was resolutely taken, and this would inevitably involve rapid investigation after death, we might have concluded that it was the evidence of advanced decomposition that we were studying.

But I think this would be a scarcely just conclusion.

It is, of course, understood that the function of the saprophytic organisms is, to instantly attack dead organic structures; whether or not their own vitality may be increased by certain modifications of environment, so that they may be able to attack *living organic tissues* whose vitality has been greatly reduced is a point which I believe extremely worthy of attention. I have certainly seen indications that this may be so.

But what is even more to our purpose is, that the whole of the large number of competent observers whose results we have reviewed, have agreed in discovering in influenza patients, alive or dead, a rather motley group of bacteria, no one of which is known to be possessed normally of the function of producing the symptoms commonly known as influenza.

It is, of course, possible that this affection may not originate in *any* microbic form; nevertheless analogy points strongly in that direction, and the question which to my mind needs as early an answer as it can obtain is this, viz., seeing that the kindred forms to the pathogenic bacteria, viz., the saprophytic organisms, are eminently mutable in *function*, although comparatively stable in form, is it not possible, and, therefore, worthy of close inquiry and research, that the several and various forms of bacilli and other bacteria found in influenza patients may not, by some means not now known to us, have become possessed of functions which make them in that state virulent to man?

I venture to believe that the question of the functional mutability of these organisms and its causes and consequences will form some considerable portion of the work of the next quarter of a century.

Binoculars.

By E. M. Nelson, F.R.M.S.

(Read May 20th, 1892.)

There has been a great deal of unnecessary confusion caused by Prof. Abbe's unwarranted attack on the late Dr. Carpenter's views with regard to the stereoscopic binocular.

Dr. Carpenter stated that orthostereoscopic effects can only be seen in an *inverting* microscope,* when there is a "cross-over," and that, if there is no "cross-over," the image will be pseudo-stereoscopic; but with an *erect* image,† if there is a "cross-over," the image will be pseudostereoscopic, and with no "cross-over," orthostereoscopic.

Prof. Abbe takes exception to this statement of Dr. Carpenter's; he puts the above proposition in another form, saying what is practically the very same thing, and of course arriving at the same results; but Abbe puts it in such a way that, while he appears to say something very different to what Dr. Carpenter says, in effect, however, he does not, and this I hope to clearly demonstrate to you.

Of the two theories, however, that of Dr. Carpenter's is the more complete. In the first instance, we must divide the subject into two parts:—

1. The "cross-over" orthostereoscopism and pseudostereoscopism.

2. The origin of the dissimilar images.

The essential point in orthostereoscopic vision with a microscope is that "the ordinary view" of objects be maintained.

* "Inverting microscope." It must be especially borne in mind that an ordinary inverting microscope transposes the image as well as inverts it. The inversion does not affect the question at all; it is the transposition which may or may not accompany the inversion that is the all-important point. I have adhered to the term "inverting microscope" because the phrase transposing microscope might lead one to suppose that it was not the ordinary instrument that was meant.

† So, too, in an erect image it is the non-transposition that is of importance.

Let us, for example, take away the compound body, eye-pieces, prisms, and all other gear, leaving only the objective, which we must suppose "sawn in two" (see specification of Holmes' patent binocular, "R. M. S. Journal," 1870, p. 274), and apply the right eye to the right half and the left eye to the left half of the objective, we shall then obtain an orthostereoscopic picture. This is a simple ideal case of an erect image with a simple microscope; it can be practically carried out by means of Beck's prisms,* which neither "cross-over" nor transpose the image.

If we interfere in the slightest with these relations by either a transposition of the image or a "cross-over," pseudostereoscopic vision will be the result. While admitting that there might be a difficulty in "sawing in two" an objective and using it as indicated above, we may nevertheless think of it as a practical construction of simple microscope.

I am not aware that Dr. Carpenter anywhere states the case in precisely this manner, but the above is the spirit and meaning of what he has written.

If you take either Holmes' "sawn in two" objective, or Beck's binocular simple microscope, and make an ordinary compound microscope of them by applying tubes and ordinary Huyghenian eye-pieces, pseudostereoscopic vision will ensue, because you will have a transposed image without a "cross-over."

If orthostereoscopic vision is required, the transposition must be corrected, and "the ordinary view" restored, either by a "cross-over" or by a retransposition of the image by means of transposing prisms or erecting eye-pieces.

Now, what does Prof. Abbe say? The cross-over is not of the slightest importance! † Yet he states it is necessary that the eye-spot images (which are the images of the objective) should be in a certain condition, which condition can only be obtained when the conditions required by Dr. Carpenter are implicitly obeyed.

There is a good deal, however, that Abbe significantly leaves

* This I have called Beck's binocular, because it is now only to be found in Beck's binocular dissecting microscope; it was, however, invented by Riddell (1851), and reinvented by Wenham (1853). "R. M. S. Journal," pp. 1-18 (1854).

† "R. M. S. Journal," 1881, p. 204, "*all other circumstances except this one*" (the nature of the eye spots) "*being immaterial.*"

unsaid, and if a careful reader will fill up the hiatus he will then see that the professor's conclusions coincide with those of Dr. Carpenter, excepting only that Abbe's are imperfect, and do not meet every case.

Prof. Abbe says that the eye-spots for orthostereoscopic vision must be like this, ᗡ D; but he does not tell you that ᗡ D in an inverting microscope without a "cross-over," and in an erecting microscope with a "cross-over," is an impossibility. He says that the eye-spots arranged like this, D ᗡ, give pseudo-stereoscopic images; but he does not say that in an inverting microscope with a "cross-over," and in an erecting microscope without a "cross-over," the attainment of that arrangement is impossible.

Prof. Abbe's law with regard to eye-spot pictures is only a partial one; suppose, instead of dividing the objective, you have two whole objectives. How will his law help you? The Chérubin d'Orléans' binocular is a case in point. The eye-spots are neither ᗡ D nor D ᗡ, but are circular, and, according to Abbe, the presence or absence of a "cross-over" has nothing to do with the question. Therefore by the Abbe theory it is quite impossible to state whether the Chérubin d'Orléans' binocular is "ortho-" or "pseudo-" stereoscopic. According to Carpenter, however, it is plain enough. The microscope is inverting; it has no "cross-over." The image is, therefore, pseudostereoscopic. The question also arises of the interpretation of the images with a single objective, when a stop like Fig. 4 is placed at the back of the objective, with, say, a Wenham binocular. The eye-spot images would be circular (Fig. 14), and in the absence of the unimportant (?) knowledge of either the transposition of the image or the "cross-over," how is one to say whether the image is "ortho-" or "pseudo-" stereoscopic. Here, again, Dr. Carpenter's theory meets the case, while that of Prof. Abbe fails.

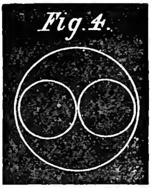


Fig. 4.

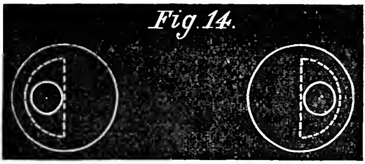


Fig. 14.

The identity of Abbe's system, as far as it goes, with that of Carpenter can be clearly seen by tracing the rays through

the various forms of binoculars. Thus let the marginal rays be called mM and the central cC, the left hand portion being in small letters, and the right hand in capitals; the aperture of the objective (say, the back lens) will be represented by mc CM. When the image is inverted the letters will be inverted thus, ɯɔ MC. By this means transposition, cross-over, and inversion will be made clear.

The following table shows how the rays leaving the objective in the order mc CM emerge at the eye-spots.

Table showing what portions of the objective image are visible at the eye-spots of various binoculars.

Left hand marginal ray at back of objective.........	m
Right ,, ,, ,, ,, ...	M
Left hand central ,, ,, ...	c
Right ,, ,, ,, ,, ...	C
Position of rays at the back of objective	mc CM

When the letters are inverted the image is inverted, otherwise the image is erect.

Name of Binocular.	Orthostereoscopic.		Pseudostereoscopic.	
	Left eye.	Right eye.	Left eye.	Right eye.
Abbe	WƆ	ɔɯ	ɔɯ	WƆ
Beck	mc	CM	—	—
Chérubin d'Orléans	—	—	L WƆ ɔɯ	R WƆ ɔɯ
Holmes	mc	CM	ɔɯ	WƆ
Nachet I.......................	WƆ	ɔɯ	—	—
Nachet II.	WƆ	ɔɯ	ɔɯ	WƆ
Powell	WƆ	ɔɯ	ɔɯ	WƆ
Stephenson	ɯɔ	ƆW	—	—
Tolles	mc	CM	—	—
Wenham	WƆ	ɔɯ	—	—

The following example shows how by my table the effects can be at once traced without the necessity of a diagram when

an erector is placed either in front or behind the Wenham prism. If it is placed in front of the Wenham prism, *i.e.*, between the prism and the objective, we have at the back of the objective mc CM, at the back of the erector WƆ ɔɯ, after the cross-over, by the Wenham prism, ɔɯ WƆ. After the transposition and inversion at the eye-piece mc CM, the "ordinary view" is restored; it is, therefore, orthostereoscopic. When the erector is placed behind the Wenham prism, *i.e.*, between the prism and the eye-piece, we have at the back of the objective mc CM, after the cross-over by the prism CM mc. After the erecting eye-pieces no change takes place; CM mc is not the "ordinary view," consequently the image is pseudostereoscopic.

There are four conditions for orthostereoscopism, viz.: (1) mc CM; (2) ɯɔ ƆW; (3) WƆ ɔɯ; and (4) MC cm. (1) is the "ordinary view;" examples, Beck's simple microscope and Tolles' compound; (2) the "ordinary view" inverted; example, Stephenson's without the erecting prism; (3) example, Wenham, Nachet is precisely the same as (1), and (4) is the same as (2). If we suppose a cube placed on a table it matters not whether we stand in front of the table or go to the other side of the table to view the cube; in both cases we will obtain orthostereoscopic effects. The same is true with the microscope; it matters not whether we stand behind or in front of a binocular. If when standing *behind* a microscope we have the "ordinary view" (1), in *front* of the microscope we get (3). Again, if when *behind* the microscope we have the "ordinary view" inverted (2), in *front* we shall get (4).

There are also four conditions for pseudostereoscopism, viz., the non-"ordinary view" (5), cm MC, its inversion (6), ɔɯ WƆ (7), the front view of (5) ƆW ɯɔ, and (8) the front view of (6) CM mc.

We have, therefore, only two things to remember—1st: The "ordinary view," mc CM. 2nd: The non-"ordinary view," cm MC; the rest are only the inversions of these two and the four front views.

Taking the binoculars in their alphabetical order we find that Abbe's is an inverting and transposing binocular eye-piece. Without the semi-circular eye-piece caps* the arrangement at

* Stereoscopism was obtained by dividing the eye-spots, by Wenham. "Journal R. M. S.," 1854, p. 4.

the eye spots is WƆ ɘɯ, WƆ ɘɯ, and as the images are precisely similar the binocular is non-stereoscopic. By means of semi-circular eye-caps the inner halves of the eye-spot images are cut out, a differential image is thus obtained, and a "cross-over" effected, which results in orthostereoscopic vision, because the transposition is corrected. If the outer halves are cut out there is no "cross-over," and as the transposition remains, pseudo-stereoscopic vision is the result.

Dr. Mercer* has pointed out that the inner halves of the eye-spots may be cut out by screwing in the tubes (Fig. 10) and the outer cut out by screwing them apart. This method of using the Abbe eye-piece is preferred by some to the employment of the semi-circular caps, which they find uncomfortable.


Fig. 10

In Beck's binocular simple microscope "the ordinary view" is not interfered with, and consequently it is orthostereoscopic; the objective is divided by prisms. Chérubin d'Orléans (1677), an early binocular, is pseudostereoscopic because there is no "cross-over," and the microscope transposes and inverts the image; the letters L and R denote the left and right hand objectives.

Holmes' "sawn in two" objective was, as first made, pseudo-stereoscopic, the image being transposed and inverted without a "cross-over;" afterwards it was fitted with erecting eye-pieces, which restored "the ordinary view" and gave an orthostereoscopic image.

Nachet I.† The first is a three-prism form with inversion, transposition, and a "cross-over."

Nachet II. is a two-prism form, which transposes and inverts; it is constructed so that by a movement of the prism it will yield either a "cross-over" or no "cross-over," and consequently both "ortho-" and "pseudo-" stereoscopic images can be obtained. In this as well as in the preceding form a prism divides the objective.

Powell is, strictly speaking, a non-stereoscopic binocular, the images in each tube being precisely similar. It was

* "Proceed. Amer. Soc. Microscopists," 1882, p. 129, and "R. M. S. Journal," 1882, p. 271.

† "Journal R. M. S.," 1854, p. 74.

designed as a non-stereoscopic binocular for use with high powers; if Dr. Mercer's method of racking in or out the tubes is used "ortho-" or "pseudo-" stereoscopic vision will be obtained. The conditions are precisely similar to those of Abbe's; repetition is, therefore, unnecessary.

Stephenson.* We may best consider this as a Holmes' "sawn in two" binocular of the pseudostereoscopic type, used in conjunction with a pair of Wheatstone's pseudoscopic spectacles. (Wheatstone's pseudoscopic spectacles consist of two transposing prisms.) Stephenson's prisms are similar to Wheatstone's, and neutralize the transposition of the images by the eye-pieces, thereby restoring "the ordinary view," with the exception of the inversion, which is left, and which does not influence the stereoscopism at all. In most binoculars of this type there is another prism to correct the inversion; the resultant image, therefore, is erect, and not transposed, but this binocular is orthostereoscopic whether the image is erect or inverted. This ingenious binocular was first invented by Riddell † in 1851, was shelved, and independently reinvented by Stephenson in 1870. In passing, let me say that the Chérubin d'Orléans binocular would make an excellent orthostereoscope with the addition of two carefully-worked Wheatstone's transposing prisms placed between the lenses of the Huyghenian eye-piece.

Tolles' binocular eye-piece is the same as Nachet I., with an erector placed between the objective and the dividing prism.

Wenham.‡ This excellent orthostereoscopic binocular passes

* "The non-inclining form alone is considered; I have left out the erecting prism, which only erects and does not transpose the image, as it does not affect the stereoscopic conditions, and only introduces unnecessary complications.

† "Journal R. M. S.," 1854, p. 20. See also 1892, p. 98.

‡ The development of this prism is interesting, and now almost forgotten. The first arrangement was similar to that now known as Beck's dissecting microscope, and when applied to the compound microscope gave pseudostereoscopic pictures. It was also applied by Wenham above the eyepiece; this gave orthosteoroscopic images with a contracted field. The second was an achromatic combination of three prisms not unlike an achromatic concave cylindrical lens—there was transposition without a cross-over; it was, therefore, a pseudostereoscope. These date (1853) and are figured in "R. M. S. Journal," 1854, p. 1. The third form was also an achromatic combination of three prisms resembling an achromatic convex cylindrical lens. In this case the transposition was corrected by a cross-over; it was, therefore, orthosteoroscopic ("R. M. S. Journal," 1860, p. 155). The fourth was the Wenham prism in its present form ("R. M. S. Journal," 1861, p. 15).

the left-hand half of the objective to the right eye direct, the right half being deflected by a prism to the left eye. It would, were it not for the transposing effect of the eye-pieces, give pseudostereoscopic vision. This is by far the most practical and best of all orthostereoscopic binoculars. There is plenty of light, the images in both tubes, if the prism is well made, are excellent, and the great ease with which the instrument can be converted to a monocular, together with its simplicity of construction, will always cause it to hold the first place.

The Abbe is an indifferent instrument; it yields a double image in the side tube, and while contracted tubes are found more agreeable to use than the semicircular eye-caps, neither can be called pleasant to work with.

The Beck is a very good plan for a simple microscope. It is better to make it with a single prism on either side, instead of four prisms, in which case it must be adjusted for the observer's own use, as it will not be possible to alter the adjustment to suit different distances of eye centres.

The Chérubin d'Orléans yields excellent results, but the construction is only possible with low powers; nevertheless, the stereoscopic effect is more perfect than in any other form.

Holmes can hardly be called a practical construction.

Nachet II.—I have not tried this form, but should think that if the two prisms were joined into one it would be an improvement, and would make a very efficient orthostereoscope.

Powell is a very good non-stereoscopic binocular.

Stephenson is the best erecting binocular. The prisms require to be very carefully worked.

Tolles is the best binocular eye-piece, but the prisms require most careful working.

The Wenham we have already discussed. Mine, with a prism by Powell, gives excellent results, *e.g.*, the secondaries of a triceratium in balsam are shown in both tubes by a $\frac{2}{3}$ of 33° and a power of 80 diameters.

An examination of the table shows the identity of Abbe's theory, as far as it goes, with that of Carpenter. Abbe's theory is shown by the cC being in the middle for orthostereoscopism, and the mM in the middle for pseudostereoscopism.

Abbe's conditions of ᗡ D and D ᗡ do not indicate the presence or absence of a "cross-over," which my table does.

Moreover, these conditions of Abbe's are non-essential, because the most perfect stereoscopic effect, either "ortho" or "pseudo," is obtained when the eye spots are circular.

The table shows that Carpenter's law in every case holds good, *e.g.*, for orthostereoscopism either "the ordinary view" must be preserved or transposition must be corrected by re-transposition or a "cross-over."

In addition to what may be called the ordinary conditions of stereoscopism, Abbe introduces a new and extraordinary one,* viz., that "orthoscopic vision is always obtained when the right half of the right pupil and the left half of the left pupil only are employed."

With regard to this an editorial note in the "R. M. S. Journal" says :†—"Prof. Abbe properly points out what has hitherto not been appreciated, that stereoscopic or pseudoscopic effect does not depend essentially on crossed or not crossed axes, but upon either the outer or inner halves of the pupils of the observer's eyes being put into action in binocular vision."

I wish to point out that it makes not the slightest difference in the image, whether the whole or a part, whether the top or the bottom, whether the right hand or the left hand portions of the pupils of the eyes are utilized.

Dr. Mercer's method of obtaining orthoscopic vision without eye caps, by making the iris cut off the inner halves of the eye spots by racking in the tubes, proves the truth of this assertion, because the inner halves of the pupils only are utilized (Fig. 10).

Dr. Mercer's method is entirely opposed to this theory of Prof. Abbe. I have frequently tried it, and find the stereoscopism quite as strong as with eye caps.

The duty of the eye caps in Prof. Abbe's orthostereoscopic binocular is to effect a cross-over. Whatever influence they may have on the pupil of the eye is quite immaterial. The contradictory statements in this paper of Prof. Abbe's are remarkable, for, speaking of the arrangement of the semi-eye spots, he says ‡ that "it is quite indifferent whether the effect is obtained with crossing or non-crossing rays, whether the image be erect or inverted or semi-inverted, and whatever

* "R. M. S. Journal," 1881, p. 204. † "R. M. S. Journal," 1881, p. 299.
‡ "R. M. S. Journal," 1881, p. 204.

elements (lenses, prisms, mirrors, etc.) may be components of the optical arrangement."

A few pages further on we read:—* "Whether or not under these circumstances orthoscopic action will require crossing over of the rays from the right hand half of the objective to the left eye piece and *vice versâ* depends solely on the manner in which the delineating *pencils* are transmitted through the system." On the same page he says:—"In the Wenham and the Nachet binoculars consequently crossing over is required;" and on the next page: "In Stephenson's binocular such crossing over is not required." Thus the things which are "immaterial" on page 204 become under precisely the same conditions "essential" on page 209.

Abbe's conditions are—1st, non-essential; 2nd, incomplete; 3rd, misleading; 4th, in no instance do they contravene Carpenter's dictum; and 5th, with regard to the action of the pupils of the eyes they are incorrect.

We have now come to the second portion of the subject, viz., the origin of the dissimilar images.

Carpenter says the origin is "perspective," but Abbe "parallactic displacement."

Stereoscopism is a difficult subject, and one which for solution does not lend itself entirely to mathematical demonstration. It is so inseparably mixed up with mental action that it can hardly be dealt with by either optical or mechanical lines of argument.

Stereoscopism or "solid view" can be obtained by one eye, for if you shut one eye a book appears solid with the other eye, but solidity is better and more perfectly seen with two eyes.

With simple microscopes (loupes) solidity is manifest, although only one eye is used. But what in these cases makes an enormous difference is the way the object is looked at. Thus semi-transparent objects, with transmitted light, exhibit very little solidity, while the same objects viewed by reflected light appear more solid with one eye than when seen in an ortho-stereoscopic binocular by transmitted light with two eyes. The light and shade which is secured by the employment of reflected light and lost with transmitted light is the cause of this heightened effect.

A curious instance of stereoscopic effect with a single picture

* "R. M. S. Journal," 1881, p. 209.

may be often seen when a photograph is projected by a lantern on a screen. I have frequently noticed the boughs of trees apparently stretching out of the screen into the room.

But to return. It is pretty obvious that if we place precisely similar images in each tube we cannot obtain the same kind of stereoscopism as when dissimilar images are presented. We nevertheless get a kind of stereoscopism which may be called a bastard stereoscopism; this can be seen in both the Abbe and Powell binoculars when the whole of the eye-spots are used. This bastard stereoscopism may also be reproduced in a single body by placing a stop over the back of the objective with two lateral apertures in it like Fig. 5. In passing I would recommend all who take an interest in the optical side of the microscope to provide themselves with a nose-piece adapter with a slit in each side of it (Fig. 6). It is useful for so many experiments, as it allows a strip of paper with apertures or stops cut in it to be placed over the back of the objective. For lens testing also it is unequalled, as the paper strip in passing through the slit causes no vibration. It can be used in conjunction with my rotary nose-piece.* In lens testing a full cone of light from the condenser should be used. It is important to understand the principle of stereoscopic pictures as seen with an ordinary stereoscope. Taking geometrical figures the two truncated square pyramids are suitable and well-known examples (Fig. 7). These very dissimilar pictures combine most perfectly in a common stereoscope, and yield "ortho-" or "pseudo-" stereoscopic effects according to the way they are placed. By holding a card between them perpendicularly to the plane of the paper the ortho-stereoscopic image may be observed without instrumental aid; the pseudo-stereoscopic image can also be seen by viewing them through a square hole in a piece of card held

Fig. 5.

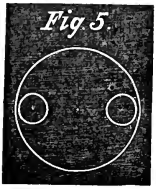


Fig. 6.

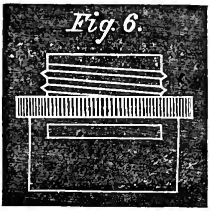
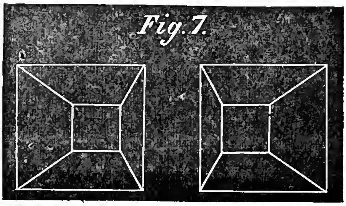


Fig. 7.

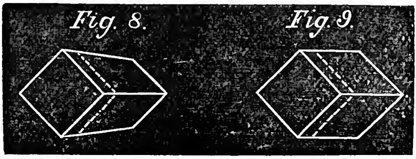


* "Q. M. C. Journal," Vol. ii. (1885), p. 153; "E. M." (1885), No. 1,042.

parallel to this page, and in such a manner that the left eye can only see the right-hand picture and the right eye the left-hand picture.

Now are these figures "perspective" drawings, or are they "parallactic displacements"? They are called perspective drawings, but in reality they are only parallactically displaced. There is no foreshortening, the base is a square, and the top is a square displaced to one side, and lines ruled joining the corners. If you consider the centre of the truncated pyramid, the focal plane, the base is parallactically displaced one way, and the truncated top the other.

These drawings, which are exact copies of those given in the text-books (originally French), are exaggerated representations of the images seen by each eye. A cube illustrates the same effect, and it matters not whether you draw it in true perspective, the edges of the side of the cube being portions of lines drawn to the vanishing point (Fig. 8), or draw it parallactically displaced with the edges of the side of the cube parallel to one another (Fig. 9).



If the drawings of the cubes are exaggerated to anything like the same extent as those of the truncated pyramid they will not coalesce; the resultant picture will be merely a super-position of two dissimilar cubes. It is the lateral displacement which is the sole and important point, and it makes no difference whether that is obtained by true perspective or by parallactic displacement, because the eye cannot distinguish between them, the displacement at its greatest being only 8°, perspective foreshortening is impossible.*

With regard to microscopical stereoscopism, if the image of a plane object, such as ruled squares, suffered perspective foreshortening by reason of aperture, different zones of the objective would yield different images, and the resultant picture would be confused. Therefore it goes without saying that a microscope image of even such an elementary object would be simply an impossibility. This Prof. Abbe ably points out.

But with regard to depth, the depth of vision is so minute

* Perspective foreshortening is as $\cos \theta : 1$; therefore for 8° it would be in the proportion of 99 to 100.

that the difference between "perspective" and "parallactic displacement" becomes infinitely small and altogether quite imperceptible to the eye. However keen in detecting errors of perspective an artist's eye might be, he would not be able in a thin object to distinguish between "parallactic displacement" and "perspective" with only 8° of displacement, in spite of the methods of drawing being so widely different. Now Prof. Abbe is perfectly right in saying that there can be no such a thing as perspective in the microscope image, and that the difference between the images seen with the right and left half of the objective is caused by parallactic displacement. The difference is, however, only one of name, because we must remember that the depth of vision in the microscope is very small (smaller than is allowed by Abbe); therefore, however thick the object may be, the thickness you can see does not amount to much, and no one could possibly distinguish between such images, whether drawn in perspective or in parallactic displacement (see dotted lines, Figs. 8 and 9).

Carpenter, it is true, uses the words "perspective projection" loosely.* He calls the pictures of the truncated pyramids "perspective projections" when they are nothing of the kind, and he uses it in the same loose way in dealing with the microscopical image.

The truncated pyramids, of course, ought to be "perspective projections" whereas they are drawn by "parallactic displacement," and the microscope image is a "parallactic displacement," though Carpenter calls it a "perspective projection." Abbe, on the other hand, unduly accentuates the difference between the microscopic and macroscopic images, so that a wholly false impression is conveyed by his paper. After rhetorical statements such as "the microscope image is a thing *sui generis;*" "peculiar property of microscopic vision is in strong contrast to the method of ordinary vision;" "elements of an object are no longer depicted as solid objects seen by the naked eye;" "an essential geometrical difference between

* The words "perspective projection" occur in Carpenter's (5th edition, 1875) article "Stereoscopic Binocular," pp. 57-73) six times in connection with ordinary vision, and once with microscopic vision. The sole passage in connection with microscopic vision is "pictures . . . . sufficiently dissimilar in their perspective projections to give when combined in the microscope a sufficient but unexaggerated stereoscopic relief."

vision with the binocular microscope and vision with the unaided eye;" "notwithstanding this difference the activities of the brain and mind blend the images so as to give rise to sensations of solidity, depth, and perspective;" "the brain arranges them so that the characteristics of solid vision are still presented," what wonder that the microscopical binocular images are held to be so entirely dissimilar to any ordinary images that it is by brain power alone that they can be turned to any account.

The truth is that there is no more brain effort required in the examination of binocular objects than there is in recognizing the similarity between two objective boxes which have been made true to one another to $\frac{1}{100}$ inch. A considerable amount of brain effort would, on the other hand, be necessary to discover their dissimilarity. Let us suppose that the two objective boxes accurately turned with the $\frac{1}{100}$ inch of difference are before us on this table, and that I was to tell this Society that "notwithstanding this difference the activities of the brain and mind blend the images so as to give rise to sensations of 'similarity;'" and again, that "the brain arranges them so that the characteristics of (similarity) are still presented," although these statements are rigidly true, I think you would be justified in denouncing them as high-flown rhetorical nonsense.

The difference between the laterally displaced images of the microscope and the perspectively projected images of ordinary vision is practically *nil* (see Figs. 8 and 9, dotted lines), and therefore no more brain effort or activity is required in viewing binocular microscope images than in viewing ordinary objects. It is aperture and focal depth that cause the parallactic displacement. If a lens has insufficient aperture the stereoscopic effect will be weak, and on the other hand if the aperture is too great there will be hyperstereoscopism. Thus there is practically no stereoscopic effect with a three-inch objective of 10° of aperture.

Stereoscopism may be said to begin with a two inch of 15° in an ordinary binocular; at the same time it should be remembered that excellent stereoscopic effects can be obtained by the Chérubin d'Orléans method and three-inch objectives, but in this case we have the axes of the lenses inclined to the object, and on that account true perspective pictures, whereas a semi-aperature of 5° gives no scope for sufficient lateral displacement.

Depth is an all-important element. There can be neither displacement nor stereoscopism in either ordinary or microscopic vision without depth. In this department of microscopy there is any amount of room for theorizing. For instance, we know that depth is reduced in the direct ratio of the increase of aperture and in a greater ratio of that of power. Therefore we might reasonably conclude that because stereoscopism is a function of depth it might be greatly reduced by an increase of power. Practically, however, such is not the case, for if you change from a two-inch to a one-inch eye-piece, you will have about a quarter of the depth, but the stereoscopism will remain constant. Again, because parallactic displacement increases with aperture, and because it is found that too great an aperture in a low power gives an hyperstereoscopic effect on opaque objects with reflected light, we might, therefore, conclude with Dr. Carpenter that there is a limit of aperture for perfect stereoscopism; in practice, however, we do not find any such limit. I have profitably used an oil immersion $\frac{1}{8}$ of 1·4 N.A., but I do find that increase of power and aperture materially degrade the quality of the image by accentuating the disturbing effect of the prism. This points the moral—the fewer prisms and the fewer surfaces the better. It is obvious, too, that the division of the back of the objective by the prism also divides the spectra, so that with a central axial cone and a stop (Fig. 4) over the back of the objective we obtain an arrangement as in Fig. 11, consisting of half a dioptric beam and four spectra (three of the first order and one of the second) unsymmetrically arranged with regard to that beam; but if we use duplex illumination * by means of a stop (Fig. 12) at the back of the condenser we secure a much better arrangement, viz., a whole dioptric beam and four symmetrically placed first order spectra as in (Fig. 13). The stop at the back of the lens is an advantage, because it keeps the

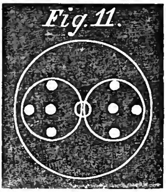


Fig. 11.

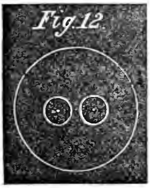
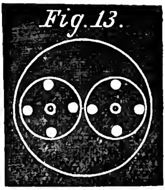


Fig. 12.

* Duplex illumination by means of mirrors was first introduced by Riddel. Stephenson used a condenser composed of cylindrical lenses and a double stop as in Fig. 12. I do not discover any advantage to be gained by the use of cylindrical lenses, and prefer the ordinary achromatic condenser.

resolution in a vertical direction equal to that in a horizontal direction.



The method and kind of illumination make an enormous difference with the stereoscopic binocular. Speaking generally reflected light by lieberkuhn or side reflector and dark ground illumination with an achromatic condenser and a stop yield excellent results. In this latter case I prefer not to use a bull's-eye.

Interesting experiments may be performed by passing a strip of paper with a hole in it across the back of the objective through the slotted nose-piece (Fig. 6); a somewhat deep object should be on the stage, and a monocular body used. By drawing the hole from the centre of the objective to its periphery, the lense being carefully focussed on a middle plane of the object, the upper part of the object within the focus is displaced one way and the lower part beyond the focus is displaced the other way. Bastard stereoscopism may be seen in a monocular by making two holes in the paper strip, so that two marginal pencils alone are passed (Fig. 5). If, with a stereoscopic binocular and a lens of 80°, a similar stop be used hyper-stereoscopism will be the result, but if the two holes be brought to the centre there will be hardly any stereoscopic effect, the best results being obtained when a stop as in Fig. 4 is used.

The position subsequently taken up by Carpenter in connection with the binocular microscope is very strange. In his writings on the subject, prior to the publication of Prof. Abbe's papers, we find a lucid and accurate (excepting only the loose use of the word perspective) explanation of the phenomena, but when he criticized the Abbe eye-piece * at the R. M. S. he contradicted all his former writings by saying that it was not an orthostereoscope, notwithstanding that the conditions were precisely the same as in the case of Wenham's and Nachet's I. and II. (see Table). The only explanation I can suggest is that he did not trace the path of the rays, and in consequence he failed to perceive that a cross-over had been effected by the eye caps.

Prof. Abbe has rightly pointed out in another paper † that

* "Journal R. M. S.," 1880, p. 1088.

† "Journal R. M. S.," 1884, p. 26.

"there is no *true* perspective difference of the images by different portions of the apertures, because the microscopic image does not admit of a perspective shortening of the lines, which are oblique to the direction of the delineating pencils." We must remember, however, that there is a difference in the amount of lateral displacement of the images by different portions of the apertures, and also that the difference between lateral or parallactic displacement and perspective projection is wholly unrecognizable in the microscope. Prof. Abbe has done excellent service in combatting the absurd idea of "all round vision." Who the author of "all round vision" was, I know not, but I do not think that theory can be fastened on the late Dr. Carpenter. It is true that he uses the word perspective in connection with the microscope image, but just before he used it in the same careless and incorrect manner when speaking of microscopic pictures. It seems to me after careful study of his article * that he did not intend the word perspective to carry with it the conception of an all round vision.

Finally his theory with regard to the 40° limit of aperture for perfect stereoscopic effects cannot be maintained, because the very slight depth of the microscope image requires a large amount of lateral displacement. I hold that when a certain stereoscopic effect has been obtained with a lens of a certain aperture, if the power be increased by means of a deeper eye-piece, the stereoscopism will remain unaltered, because the lateral displacement is magnified equally with the object. Thus if a series of spheres diminishing in size were examined with a certain lens under varying powers, whatever might be the character of the stereoscopism of one of the larger spheres with a low power, *i.e.*, whether the effect was under, sufficient or hyper-stereoscopic, a smaller sphere under a higher power would exhibit the same degree of stereoscopism, the illumination remaining the same in both cases.

The best stereoscopic effects are obtained when a stop (Fig. 4) is used at the back of the objective and duplex illumination employed. Great caution is necessary, so that the effect shall be sufficient, and neither over nor underdone. The best plan when the lens has been selected is to try various card-board stops, and when the proper size is found, have them made

* Carpenter, 5th Edition, 1875, p. 70.

in metal. Note, hyperstereoscopism can be easily produced by the use of a too large stop at the back of the condenser for dark ground illumination; this, therefore, should be carefully avoided.

In conclusion it must be remembered that duplex illumination alters the conditions, and, to a certain extent, upsets the rigid theory, because an axial pencil is sent excentrically through each half of the lens (Fig. 13).

Explanation of some of the Figures.

Fig. 4.—A stop to be placed at the back of the objective. A separate one is required for each lens.

" 12.—A stop to be placed at the back of the condenser. A special one is required for each objective.

" 11.—The white dots show the spectra, the ring in the centre represents the dioptric beam.

" 13.—The rings in the centre of each circle represent the dioptric beams. The white dots are spectra.

" 7.—Parallactic drawings of two truncated square pyramids, the displacement is greatly exaggerated.

" 8.—A square parallelopiped drawn in perspective.

" 9.—The same drawn by parallactic displacement.

" 10.—Illustrates orthostereoscopism by Dr. Mercer's method. The dotted lines denote the eye-spots or Ramsden's circles. The figure shows that when the tubes are racked in the eye-spots are brought closer together, so that the outer portions of the eye-spots pass through the inner portions of the pupils. In opposition to this Abbe and the editorial staff at the R. M. S. state that orthostereoscopism is due to the employment of the outer halves of the pupils. The cause of orthostereoscopism in Dr. Mercer's experiment as well as in the Abbe eye-piece is due to the fact that the suppression of portions of the eye-spots effects a "cross-over."

Some New Records of British Cladocera.

By D. J. Scourfield.

(Read May 20th, 1892.)

Plates IV. and V.

During the last three years I have repeatedly found a few species of Cladocera which, although fairly well known on the Continent and even in some cases in America, do not seem to have been hitherto recognized as British. I am well aware that it would not be wise to insist very strongly on this point in regard to every one of these species, as there certainly do exist some indirect references, in Baird's classic work on the British Entomostraca, to forms very similar to, if not identical with, two of those described below. These references can, however, scarcely be looked upon as definite records, and consequently have but little bearing upon the title of this paper. Moreover, in each of the uncertain cases I have also seen the male.

As further introduction appears to be unnecessary in such a case as this, I will at once proceed with a short description of the species referred to, numbering six in all.

Ceriodaphnia megops, G. O. Sars (Plate IV, Figs. 1-3).—This is a very fine species, and may be easily recognized, as it departs rather widely from the normal type of the genus. The striated shell of the female, and the greatly elongated antennules of the male, distinguish it at once from all its allies, with the exception, perhaps, of a doubtfully distinct form, *C. cristata*, described in America by Prof. Birge.

Female.—Transparent, sometimes with a tinge of pink. Large antennæ, always more or less pink. Head prominent ventrally, with only a very shallow bay anteriorly, and a slight angulation in front of the antennules. Shell rather long and somewhat rectangular, the dorsal and posterior margins meeting in a blunt angle. Markings consisting of faint transverse striæ, very

similar to those of the common *Simocephalus vetulus.* The striæ occasionally coalesce, thus enclosing long lenticular areas. On the ventral margin they merge into an irregularly hexagonal reticulation. Tail obliquely truncate at its extremity, and provided with a double series of spines on each side of the anus. Anterior to the latter is also a median line of little curved thorns, diminishing in size forwards. The outer or principal of the two anal rows consists of from seven to nine spines, the longer or posterior ones being nearly straight and sharp as needles. The inner row comprises a larger number of smaller spines, but it can only be seen with some difficulty between the large spines of the outer row. The two terminal tail claws are rather slender, with a lateral line of fine hairs, but are without accessory teeth. There are two dorsal spurs on the abdomen, the posterior being only about a quarter of the length of the anterior. The number of eggs carried at one time in the brood chamber is often numerous, sometimes as many as ten. Ephippium with one egg. Length $\frac{1}{25}$in.

The following are the places where I have so far found it:—Wanstead Park, Essex, August and September, 1889, May to October, 1890, August and September, 1891; Ditch at Horning Ferry, Norfolk, August, 1890; Golding's Hill Ponds, Loughton, Essex, August, 1891.

Male.—My specimens were reddish all over, and could be easily distinguished from the female by their colour, even with the naked eye. The head is more erect than in the female, and more deeply bayed on the top. Dorsal margin of the shell very nearly straight, with the blunt angle minutely spined. The shell markings are peculiar. At the ventral margin they consist of irregular hexagons as in the female, but across the middle of the valves they are somewhat diamond-shaped, intermediate, in fact, between true hexagons and the long striæ characteristic of the female. The tail is almost identical in shape and armature with that of the female. The antennules and first pair of feet are, however, very different. The former are much elongated, and apparently two-jointed. The lateral seta is near the middle of the long joint, which also bears at its tip the usual bunch of sensory hairs and a long flagellum. This flagellum, which is about the same length as the antennule, is slightly bent towards the body in the middle of its length, and terminates in a small

curved expansion. The first foot is provided with a strong hook, and a long filament very closely resembling the flagellum of the antennule. Length $\frac{1}{34}$in.

The only examples I have seen were taken at Wanstead Park, Essex, September, 1891. They exceeded the females in number in that gathering, and all the latter carried ephippia.

It seems very probable that Baird found this form, although including it with *C. reticulata*, for in the "Natural History of the British Entomostraca" there is a drawing of a so-called *Daphnia reticulata* (Tab. vii., Fig. 5), having the shell striæ, and even the general outline of the present species. Nothing, however, is said in the text about a *D. reticulata* with striated valves. The description of *D. reticulata* only states that "the surface is covered with a complete meshwork of small hexagonal cells."

Ceriodaphnia quadrangula, O. F. Müller (Plate IV, Figs. 4-7).—The form here referred to O. F. Müller's *Daphnia quadrangula*, is a much smaller species than the foregoing, and not nearly so readily distinguished. It closely resembles a small *C. reticulata*, but its shell-sculpture is fainter, while the tail-claws are without the accessory teeth, so well marked in that species.

Female.—Very light straw-coloured or more rarely slightly red. Head with a distinct bay anteriorly, and a moderate angulation in front of the antennules. Fornices covering the bases of the large antennæ rather prominent, with or without a little spine at their extreme lateral extension. Cervical groove deep. Dorsal margin of shell well arched, with a rather sharp angle posteriorly. Shell-markings nearly regular hexagons, distinct, but not very strong compared with some other species of the genus. Tail slightly tapering towards the extremity, which is rounded dorsally. Terminal claws without accessory teeth. The anal spines, numbering about ten, are stout and recurved. Just anterior to the anus, and on a level with the smaller anal spines, are two rows of three or four long and slender setæ closely approximated to the middle line of the tail. This feature seems constant in all the specimens I have examined, but I have not seen it referred to by previous authors. The brood chamber is closed by one abdominal spur, which is followed by

two very much smaller projections. The number of eggs is generally four. Ephippium with one egg. Length $\frac{1}{38}$ in.

My notes of its occurrence are as follows:—Wanstead Park, Essex, May to November, 1890, March to November, 1891, April, 1892; Filby Broad, Middle Dyke, and Ditch at Wroxham, Norfolk, August, 1890; Higham Park, Woodford, Essex, May and August, 1891; Eagle Pond, Snaresbrook, Essex, October, 1891; Royal Botanic Gardens, Regent's Park, London, April, 1892; Golding's Hill Ponds, Loughton, Essex, April, 1892.

Male.—Colour same as female. Head large, dorsal and ventral margins of the shell nearly straight. Shell markings as in the female. Antennules but little enlarged, with a flagellum barely twice as long as the terminal tuft of sensory hairs. First feet with a hook and a long filament. Tail practically the same as in the female. Length $\frac{1}{50}$ in.

Wanstead Park, Essex, September and October, 1891.

The form figured by Baird as *D. reticulata*, var. *quadrangula*, may have been the ephippial female of the present species, but the details given are scarcely sufficient to make the reference even moderately certain.

Daphnia hyalina, Leydig (Plate V, Fig. 1).—This is one of the group of species of the genus Daphnia, which delight in the clear water of ponds and lakes free from weeds. It comes rather close to some of the varieties of *D. longispina*, but is more transparent, has a taller head, and fewer anal spines.

Female.—Hyaline. Head rounded, and nearly one-third the whole body length, but not much crested. Its ventral margin is decidedly concave. Shell-spine very long, often one-half the length of the animal. Shell markings rhomboidal. Compound eye with prominent lenses arranged regularly around the nearly black mass of pigment. Simple eye with a small spot of dark pigment. Tail armed with from eight to ten anal spines. Terminal claws smooth, *i.e.*, without accessory teeth Large specimens may sometimes be seen carrying from ten to twelve eggs, or even more, but they are usually less numerous than this. I have not observed the ephippial female. Length $\frac{1}{18}$ in. without shell-spine. Specimens from the Eagle Pond, Snaresbrook, are usually less than this, however, while those from Connaught Water, Chingford, are occasionally more, even reaching $\frac{1}{14}$ in.

I have taken it as follows:—Connaught Water, Chingford, Essex, September, 1890 and 1891; Eagle Pond, Snaresbrook, Essex, November, 1890, and October, 1891; "Green Man" Pond, Leytonstone, Essex, November, 1891; Wanstead Park, Essex, April, 1892.

The *male* has not yet been seen.

Daphnia galeata, G. O. Sars (Plate V, Figs. 2 and 3.).—This is similar in most respects to the preceding, and is, like it, found only in clear water. It differs chiefly in its smaller size, and slightly taller and distinctly pointed head. There can be little doubt that it is the *D. galeata* of Sars, although its claim to specific rank seems uncertain.

Female.—Hyaline. Head well crested, one-third as long as the animal, more or less sharply pointed, with a nearly straight or slightly concave ventral margin. Shell-spine long, quite one-third total body length. Shell-markings rhomboidal as usual in this genus. Lenses of the compound eye distinct and regularly arranged. Simple eye with a pigment spot. Tail with seven to nine small anal spines. Terminal claws smooth. Summer eggs usually few. Ephippium with two eggs. Length, $\frac{1}{25}$ in. without shell-spine.

Wanstead Park, Essex, September, 1890, August to November, 1891.

Male.—Head more sharply pointed than that of the female, body more rectangular, shell-spine nearer dorsal margin and pointing obliquely upwards. Antennules enlarged (compared with female) and movable. Each with a minute lateral seta near tip, and a terminal flagellum in addition to the usual tuft of sense hairs. Flagellum short, not exceeding the sense hairs in length. First feet with a hook and a long filament, which seems to be minutely setose near the free end. Length, $\frac{1}{30}$ in. without shell-spine.

Wanstead Park, Essex, September and October, 1891.

Alona intermedia, G. O. Sars (Plate V, Figs. 4 and 5).—I have usually found this species either in dense masses of algæ floating in clear water, or else in shallow ponds thickly grown with aquatic plants. It is one of the smaller forms of the genus, and might be mistaken for *A. guttata*, from which it differs mainly in the shape and armature of the tail.

Female.—Yellow or yellowish brown. Dorsal margin of carapace well arched, meeting posterior at a very obtuse angle. Ventral margin nearly straight, fringed with hairs, and rounded behind. Shell marked with faint longitudinal ridges. Simple eye about half the size of the compound, and slightly nearer to it than to the tip of the rostrum. Antennæ small. Tail short and rounded at the end. Furnished on each side of the dorsal edge with a row of minute spines in groups of three or four. There is also a lateral row of teeth, but they are very faint. Terminal claws with a small spine at the base. Eggs usually two. Length, $\frac{1}{70}$ in.

Found in the following localities:—Wanstead Park, Essex, November, 1889, September, 1890, October, 1891; Cuckoo Pits, Chingford, Essex, September, 1890; Victoria Park, London, November, 1890; Eagle Pond, Snaresbrook, Essex, November, 1890 and 1891.

So far, I have not seen the *male*.

Chydorus ovalis, Kurz. (Plate V, Figs. 6 and 7).—The genus *Chydorus* comprises some nine or ten recognized species, of which one, *C. sphericus*, is extremely abundant everywhere, while the remaining forms are rare and local. The former consequently is well known, while the latter are very little known, and probably often confounded with the common species. There can be little doubt that this has often happened in the case of the present species. It may be distinguished, however, from *C. sphericus* by the absence of evident reticulation on its more evenly ovoid shell, and by its somewhat broader tail.

Female.—Colour red. Shell oval or somewhat egg-shaped, not truncate posteriorly, nor angulated ventrally. Shell markings hexagonal, but so extremely ill-defined as to be easily overlooked. Eye-spot nearer to the compound eye than to the end of the rostrum, a little more than half the size of the former. Antennules spindle-shaped, with a lateral seta near the middle, and a couple of sense hairs just anterior to the terminal bunch. Tail rather broad, with a prominent pre-anal projection. It is rounded at the extremity and armed with twelve or thirteen little teeth. Terminal claws with two basal teeth, the anterior of which is very minute. Eggs two.

Length, $\frac{1}{47}$ in. Kurz* seems to have had rather smaller examples, for he gives the length as 0·4 m.m. He also shows the tail a little more tapering towards the end, and with fewer spines, than was the case in my specimens, but these points of difference seem scarcely sufficient to separate the two forms.

Eagle Pond, Snaresbrook, Essex, October, 1891. Sphagnum Pool, Leyton Flats, Essex, November, 1891.

The *male* is still unknown, I believe.

Description of Plates.

IV.

Fig. 1.—*Ceriodaphnia megops.* ♀ × 60.
„ 2.— „ „ ♂ × 60.
„ 3.— „ „ Tail of ♀ × 150.
„ 4.—*Ceriodaphnia quadrangula.* ♀ × 90.
„ 5.— „ „ ♂ × 90.
„ 6.— „ „ Tail of ♀ × 180.
„ 7.— „ „ Ditto (dorsal view to show inner rows of pre-anal spines—diagrammatic.)

V.

Fig. 1.—*Daphnia hyalina.* Head of ♀ × 65.
„ 2.—*Daphnia galeata.* ♀ × 65.
„ 3.— „ „ ♂ × 65.
„ 4.—*Alona intermedia.* ♀ × 110.
„ 5.— „ „ Tail of ♀ × 250.
„ 6.—*Chydorus ovalis.* ♀ × 80.
„ 7.— „ „ Tail of ♀ × 180.

* "Dodekas neuer Cladoceren," Sitzungberichte der kaiserlichen Ak. der Wiss.—Math. Nat. classe, Band 70, Abth. 1. Vienna, 1874-5.

In Memoriam.

WALTER W. REEVES.

By Frederic Hy. Ward, M.R.C.S., F.R.M.S.

In a Club like ours, in which the social element is one of the most distinctive features, it would not be meet to allow the death of one of its original founders to pass by without remark. To chronicle our loss becomes still more a duty in the case of our late friend Mr. Reeves, who from his punctual attendance at all meetings, and constant readiness to assist in all matters pertaining to the interests of the Club, might almost be looked upon as its father, rather than one only of its original founders.

I could wish that the duty of recording his worth had been committed to more competent hands than mine, but I feel that his name will remain to the last in the affectionate remembrance of his friends and fellow-members, and that nothing can be said or written by anyone which could make it more enduring.

Walter Waters Reeves, the eldest son of Thomas Waters Reeves, was born on February 14th, 1819, at Beckley, in Sussex, and was educated under Dr. Davies at the Cranbrook Grammar School. While a schoolboy he showed his fondness for natural history, and was continually collecting specimens. Nothing delighted him more than rambling in the woods and fields, and searching the banks and hedgerows for anything that was alive. Returning home, he would triumphantly produce from his pockets his captures—not always, however, to an admiring home circle when these consisted of snakes or other creatures usually viewed with some repugnance. About this time he made a very good collection of the eggs of British birds, which he subsequently presented to a local museum. He was by no means a collector merely. He carefully watched and studied the birds and their habits at the different seasons, and made himself familiar with their different notes and songs. Down to a very late period he would identify any bird by a few

notes, or its mode of flight, where these are distinctive, and I remember his complaining to me comparatively recently that he thought his memory was failing, as he could not always tell what birds he heard.

On his leaving school it was decided that he should enter the medical profession, and with this object in view he was articled to a surgeon at Maidstone, where he remained some years. It was here that he commenced the study of botany, to which he devoted most of his leisure time. He thought no trouble too great to be taken in this his favourite pursuit, and soon became acquainted with all the plants in the neighbourhood, often walking 20 miles or more before breakfast that he might find some fresh specimen or obtain material for examination at home. He speedily acquired a very good collection, with the assistance of some of the well known botanists of that day, and on his leaving Maidstone his herbarium contained specimens of almost every British plant, ferns as then classified being particularly well represented. When his period of pupilage expired he was not ambitious to advance himself in his profession by coming to London and entering on hospital work; in fact, the very idea of hospital practice or operative surgery was repugnant to him. To abandon natural history pursuits was a sacrifice too great, and he went in preference to Farnham as assistant to a surgeon, and afterwards to Tunbridge Wells in the same capacity. I think it was about this time that he had an attack of rheumatic iritis, which permanently injured the sight of one eye, and after laying him by for a considerable time led him to renounce the idea of qualifying for practice.

Almost as soon as photography became a practical art he entered upon it with a good deal of zest, and was even in business for a short time as a photographer. From some cause or other it did not turn out to be very profitable, and there is little doubt that so far as the trade element was concerned he was unfitted for it. By the wax paper process he secured negatives of most of our native ferns, and at one time contemplated issuing a complete series of prints from them. He also, by the same process, commenced a series of views of the parish churches in the neighbourhood. Those who are acquainted with the difficulties of this branch of photography would be astonished at the merit which some of these negatives display.

In 1864 Mr. Reeves joined the Royal Microscopical Society, and in 1868 he was made Assistant Secretary.

The appointment he held for 16 years, and on his resignation, in consideration of his services, he was presented with the sum of £100.

Members of the Quekett will remember with pleasure that about this time they embraced the opportunity of his retiring from office to present him with an illuminated address and a purse of sovereigns in recognition not only of his services to microscopy, but also of the esteem in which he was held. This was always a source of great gratification to him, and the address henceforth held a prominent position in his room above the table devoted to microscopic appliances.

It would be unnecessary to detail here the services he rendered to our Club as a Member of the General and Excursion Committees. Virtually he was the leader of the excursions and botanical referee, and so long as the annual dinner was held at Leatherhead he was the principal organizer of the day's proceedings. At the ordinary meetings of the Club he was perhaps the most constant attender, and the register would show that the nights on which he was absent were very, very few.

Towards the close of last year his health began to fail, and his friends noticed an unusual pallor in his face and a gradual loss of flesh. He had complained of rheumatic pains at times for many years, but they were never so bad as to confine him to the house. The first symptoms of his malady--cancer of the stomach—were sickness with diarrhœa, which kept him to his rooms for nearly a week. He would not admit it was anything more than a bilious attack, but after it had recurred several times, and he had on each occasion vomited much blood, he acknowledged that he was failing, and said he wanted someone to nurse him. With this object in view he left London on 30th January, and went to reside with his sister at Middleton Vicarage, taking with him his two pet dormice, which had been his companions for some time. He did not at first appear to have suffered from the journey, but a day or two after his arrival he got worse, and on February 5th he had frequent vomiting of blood. In a few days he rallied, and was able to sit up a little in his bedroom each day, was in his usual good

spirits, and frequently talked of the plans he had formed of returning to London to superintend the packing of his treasures and of paying a round of final visits to his friends, before settling down for the remainder of his life in that little Yorkshire village.

On the 24th, however, the same distressing symptoms returned; he became very weak, and it was with great difficulty he could be coaxed into taking any nourishment. In a few days, with the cessation of the sickness, he again improved, and his spirits revived, but he appeared unable to recover the ground he had lost; for seven or eight hours in the day he would sit up in his bedroom, but was unable to get downstairs. On March 15th he went out into the garden, only remaining a few minutes, and he was glad to return within doors. Shortly after he was seized with acute pàin in the stomach, and was helped to bed. On the following day all the worst symptoms returned, and again on the 22nd, lasting each time for two or three days. On the 29th he confessed that he felt more ill than he had ever done before; for a day or two was in a very prostrate condition, quite unable to sit up in bed, and took very little interest in anything. Shortly after this he rallied, and from that time had no further return of the sickness. Towards the end of April he was much better, and it was arranged that his niece, who had been nursing him most assiduously, should come up to London, and superintend the packing of his herbarium, books, etc., and he gave special instructions that one of his botanical presses should be sent off at once, as he was contemplating pressing some plants. On the last day of the month all his belongings arrived safely, and he was relieved of the anxiety he had felt, lest any of his apparatus, slides, books, or plants should be injured in the transit. At this time I received two letters written to his dictation, but signed by himself, though the contents were quite in his old style, cheerful and, of course, botanical, when I saw his signature I felt that there was great cause for alarm. But when I heard on May 9th that he was in good spirits and had been visited by some old friends, to whom he had been showing plants and slides, and quite with his old fervour, that he had had no return of the bad symptoms, I began to hope that, as the weather got warmer, he might gain strength and

be able once more to get out into the country that he loved, but it was not to be.

Early on the morning of the 16th he became suddenly worse, had acute pain, and was almost collapsed. He obtained relief from the remedies used, and had some hours' sound sleep, but the weakness increased, there appeared to be no power to rally, and at 6 p.m. on the next day he began to sink. Propped up in bed, he retained his consciousness, and at 11 p.m. wished his niece good-night for the last time, then, slowly and calmly sinking, passed away without a sigh or a single struggle, in his sister's presence, at 3.30 the next morning. On the following Saturday his mortal remains were laid to rest in the little churchyard by his brother-in-law, the Vicar of Middleton.

And now to say the last words. Mr. Reeves was of a modest and retiring disposition; his voice was very rarely heard in public, though there were very few subjects that came before our meetings on which he could not have said something. He had a good, all-round knowledge of matters connected with the microscope, but, owing to his limited sight, he did not work much with that instrument. He was, before all things, a botanist—one of the old type of field botanists—and could at once, almost invariably, give the name to any plant he might meet with in his rambles, and nothing gave him greater pleasure than to see them growing in their native habitats. For over twelve years, and for some thousands of miles, I have accompanied and collected with him, and it was indeed a rare occurrence if he did not find the things he went in search of. The most marked trait in his character was gentleness; few could have fewer enemies or more friends. His fellow members will not readily forget his kindly features and his genial smile. The place he has left vacant in our Club will remain vacant—our friend will return no more.

Q.M.C. EXCURSIONS, 1890.

March 29th.

List of Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London, by Messrs E. T. Browne, Burton, Parsons, Rousselet, and Scourfield.

PROTOZOA.

Acineta mystacina.
,, *tuberosa.*
Dinobryon sertularia.
Epistylis anastatica.
,, *flavicans.*
,, *plicatilis.*
Opercularia nutans.
Podophrya mollis.
,, *elongata.*
Stentor polymorphus.
,, *Rœselii.*
Vorticella campanula.
,, *longifilum.*
,, *microstoma.*
,, *nutans.*

VERMES. Rotifera.

Anuræa aculeata.
,, *cochlearis.*
Asplanchna Brightwellii.
,, *priodonta.*
Brachionus angularis.
,, *pala.*
,, *quadratus.*
,, *rubens.*
,, *urceolaris.*
Distyla flexilis.
Euchlanis deflexa.
Floscularia campanulata.
Limnias ceratophylli.
Melicerta ringens.
Notholca scapha.
Œcistes crystallinus.
Polyarthra platyptera.
Rotifer macrurus.
,, *vulgaris.*
Synchæta pectinata.
,, *tremula.*
Triarthra longiseta.

CRUSTACEÆ. Entomostraca.

Alona quadrangularis.
Bosmina longirostris.
Candona candida.
,, *fabæformis.*
,, *pubescens.*
Canthocamptus minutus.
Chydorus sphæricus.
Cyclops pulchellus.
,, *Scourfieldii.*
,, *serrulatus.*
,, *tenuicornis.*
,, *viridis.*
Cypria opthalmica.
,, *serena.*
Cypridopsis vidua.

Diaptomus ? gracilis.
Ilyocryptus sordidus.
Leydigia acanthocercoides.
Pleuroxus trigonellus.
Simocephalus vetulus.
MOLLUSCOIDA. Polyzoa.
Fredericella sultana.
Paludicella Ehrenbergii.

Attendance: Twenty-six members of the Club, seventeen members of other Societies, and twelve visitors. Total, 55.

April 12th.

Objects Found on the Excursion to Snaresbrook, by Messrs. Parsons, Rousselet, and Western.

PROTOZOA.
Condylostoma stagnale.
Dinobryon sertularia.
Nassula ornata.
Stentor polymorphus.
VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*
,, *cochlearis.*
,, *serrulata.*
Asplanchna priodonta.
Brachionus angularis.
,, *pala.*
,, *quadrata.*
,, *rubens.*
,, *urceolaris.*
Copeus labiatus.
Euchlanis pyriformis.
,, *triquetra.*
Floscularia coronetta.
Limnias ceratophylli.
Mastigocerca bicornis.
Melicerta conifera.
Notholca scapha.
Notops brachionus.
,, *hyptopus.*
Œcistes crystallinus.
,, *intermedius.*
Polyarthra platyptera.
Rhinops vitrea.
Rotifer citrinus.
Stephanoceros Eichhornii.
Synchæta pectinata.
,, *tremula.*
Triarthra longiseta.
MOLLUSCOIDA. Polyzoa.
Fredericella sultana.

Attendance: Eleven members of the Club, three members of other Societies, and two visitors. Total, 16.

April 26th.

Objects Found on the Excursion to Hayes and Keston Commons, by Mr. Rousselet.

PROTOZOA.
Amphileptus flagellatus (Rousselet), n.s.
Didinium nasutum.
Dinobryon sertularia.
VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*

Anuræa cochlearis.
Asplanchna priodonta.
Brachionus angularis.
,, *pala.*
Polyarthra platyptera.
Rhinops vitrea.
Synchæta pectinata.
Triarthra longiseta.
MOLLUSCOIDA. Polyzoa.
Fredericella sultana.

Attendance: Seven members of the Club.

May 10th.

Objects Found on the Excursion to Richmond Park.

PROTOZOA.
Dinobryon sertularia.
Ophridium versatile.
Stentor niger.
,, *polymorphus.*
Trachelius ovum.
VERMES. Rotifera.
Anuræa aculeata.
,, *cochlearis.*
Brachionus rubens.
Dinocharis pocillum.
Floscularia cornuta.
Œcistes crystallinus.
Polyarthra platyptera.
Rotifer macroceros.
Stephanoceros Eichhornii.
Taphrocampa annulosa.
Triarthra longiseta.

Attendance: Ten members of the Club, four members of other Societies, and one visitor. Total, 15.

May 31st.

Objects Found on the Excursion to Staines, by Messrs. Burton and Rousselet.

CRYPTOGAMIA. *ALGÆ.*
Desmidiaceæ.
Closterium moniliferum.
Cosmarium crenatum.
Xanthidium fasciculatum.
PHANEROGAMIA.
Utricularia vulgaris.
PROTOZOA.
Ceratium fusus.
Dinobryon sertularia.
Euplotes patella.
Stentor polymorphus.
Trachelius ovum.
VERMES. Rotifera.
Anuræa aculeata.
Anuræa cochlearis.
Asplanchna priodonta.
Asplanchnopus myrmeleo.
Brachionus pala.
Euchlanis triquetra.
Mastigocerca rattus.
Monostyla lunaris.
Notommata aurita.
Polyarthra platyptera.
Proales parasita.
Rotifer vulgaris.
Salpina redunca.
Stephanoceros Eichhornii.
Taphrocampa annulosa.

Attendance: Ten members of the Club, two members of other Societies, and three visitors. Total, 15.

June 14th.

OBJECTS FOUND ON THE EXCURSION TO WHITSTABLE, BY MR. WADDINGTON.

PORIFERA.
Grantia.
Leucosolenia.
CŒLENTERATA. HYDROZOA.
Campanularia.
Coryne pusilla.
Sertularia.
Tubularia indivisa.
ACTINOZOA. CTENOPHORA.
Beröe, sp.
Pleurobrachia.
ECHINODERMATA.
Ophiocoma.
Ophiura.
Solaster papposa.
VERMES.
Cirratula.
Sabella.
CRUSTACEA.
Caprella.
Nymphon gracile.
Pagurus Bernhardus.
Pycnogonum.
MOLLUSCOIDA. POLYZOA.
Bowerbankia imbricata.
Eucratia chelata.
Crisia.
Flustra.
Membranipora.
TUNICATA.
Amaroucium.
Botryllus
Clavellina.
Cynthia.
Perophora Listeri.

Attendance: Twelve members of the Club and three members of other Societies. Total, 15.

June 28th.

OBJECTS FOUND ON THE EXCURSION TO OXSHOTT, BY MESSRS. CHAPMAN, OAKDEN, PARSONS, AND WESTERN.

PROTOZOA.
Dinobryon sertularia.
Stentor polymorphus, green var.
VERMES. ROTIFERA.
Anuræa brevispina.
,, *serrulata.*
,, *tecta.*
Cephalosiphon limnias.
Conochilus volvox.
Copeus cerberus.
,, *pachyurus.*
Dinocharis tetractis.
Euchlanis triquetra.
Floscularia cornuta.
Furcularia longiseta.
Limnias myriophylli (Western = *Limnioides myriophylli*, Tatem).
Mastigocerca bicornis.
,, *bicristata.*
Melicerta conifera.
Notops brachionus.
,, *hyptopus.*

Œcistes crystallinus.
,, *pilula.*
,, *umbella.*
Polyarthra platyptera.
Rotifer macroceros.
,, *vulgaris.*
Salpina brevispina.
,, *mucronata.*
Stephanops muticus.
,, *unisetata.*
Synchæta pectinata.
Taphrocampa annulosa.
ARACHNIDA. ACARINA.
ORIBATIDÆ.
Notaspis lacustris, adults and nymphs.
HYDRACHNIDÆ.
Arrenurus caudatus, ♂
,, *globator*
Hygrobates, sp.

Attendance: Eight members of the Club and four members of other Societies. Total, 12.

July 12th.

OBJECTS FOUND ON THE EXCURSION TO TOTTERIDGE, BY MESSRS. E. T. BROWNE, BURTON, PARSONS, AND WESTERN.

PROTOZOA.
Anthophysa vegetans.
Arcella aculeata.
Ceratium fusus.
Coleps hirtus.
Condylostoma stagnale.
Difflugia aculeata.
,, *globosa.*
,, *pyriformis.*
,, *urceolata.*
Dinobryon sertularia.
Euplotes patella.
Paramecium aurelia.
Stentor niger.
,, *polymorphus.*
Vaginicola crystallina.
VERMES. ROTIFERA.
Anuræa aculeata.
,, *cochlearis.*
,, *tecta.*
Brachionus angularis.
,, *Bakeri.*
,, *pala.*
,, *rubens.*
Cœlopus porcellus.
Colurus bicuspidatus.
Dinocharis tetractis.
Eosphora aurita.
Euchlanis dilatata.
Floscularia campanulata.
,, *cornuta.*
,, *ornata.*
,, *gracilis.*
,, *longiseta.*
Limnias ceratophylli.
Mastigocerca bicornis.
,, *carinata.*
,, *rattus.*
,, *stylata.*
Melicerta ringens.
Monostyla cornuta.
Notommata aurita.
Notops hyptopus.
Œcistes crystallinus.
Philodina citrina.
Polyarthra platyptera.
Pompholyx sulcata.
Rotifer tardus.
Sacculus viridis.
Salpina brevispina.

Scaridium longicaudum.
Stephanoceros Eichhornii.
Stephanops lamellaris.
Synchæta pectinata.
,, *tremula.*
Triarthra breviseta.
,, *longiseta.*

GASTROTRICHA.
Dasydytes fusiformis.
TURBELLARIA.
Planaria lactea.
,, *nigra.*
ARACHNIDA. ACARINA.
Limnochares aquaticus.

Attendance: Nine members of the Club and three members of other Societies. Total, 12.

July 26th.

OBJECTS FOUND ON THE EXCURSION TO GUILDFORD, BY MESSRS. E. T. BROWNE, CHAPMAN, PARSONS, AND WESTERN.

PORIFERA.
Larval (planula), stage of a spongilla.

VERMES. ROTIFERA.
Dinops longipes, n.s. (Western).
Megalotrocha albo-flavicans.

Attendance: Eight members of the Club and two members of the South London M. and N. H. Club. Total, 10.

August 30th.

OBJECTS FOUND ON THE EXCURSION TO WOKING, BY MESSRS. E. T. BROWNE, CHAPMAN, PARSONS, AND WESTERN.

PROTOZOA.
Difflugia proteiformis.
Rhipidodendron Huxleyi.
Stentor niger.
Trachelius ovum.
Vorticella campanula.
VERMES. ROTIFERA.
Anuræa aculeata.
,, ? *brevispina*, var., with only one posterior spine.
Cephalosiphon limnias.
Copeus pachyurus.
Dinocharis tetractis.
Euchlanis triquetra.
Floscularia ambigua.
,, *campanulata.*
,, *cornuta*, var., with horn of extraordinary length.
Floscularia coronetta.
,, *longicaudata.*
Furcularia longiseta.
Limnias ceratophylli.
Mastigocerca bicornis.
Melicerta conifera.
Microcodon clavus.
Monostyla lunaris.
Œcistes brachyatus.
,, *crystallinus.*

Œcistes pilula.
,, *umbella.*
Philodina aculeata.
,, *macrostyla.*
Polyarthra platyptera.
Pterodina patina.
Rotifer macroceros.
,, *macrurus.*
Stephanops unisetatus.
Synchæta pectinata.
Taphrocampa annulosa.
ARACHNIDA. Arctisconidæ.
Macrobiotus Hufelandii.
MOLLUSCOIDA. Polyzoa.
Cristatella mucedo.
Fredericella sultana.
Paludicella Ehrenbergii.
Plumatella repens.

Attendance: Seven members of the Club, and three members of the South London M. and N. H. Club. Total, 10.

September 13th.

Objects Found on the Excursion to Chingford, by Messrs. E. T. Browne, Oxley, Parsons, Scourfield, Spencer, and Percy Thompson.

PROTOZOA.
Amœba proteus.
Amphileptus gigas.
Arcella vulgaris.
Centropyxis aculeata.
Difflugia (=*Trinema*) *enchelys.*
Difflugia lobostoma.
,, *pyriformis.*
,, *spiralis.*
,, *urceolata.*
Dinobryon sertularia.
Halteria grandinella.
Stichotricha aculeata.
Stylonichia mytilus.
Urocentrum turbo.
VERMES. Rotifera.
Anuræa serrulata.
,, *tecta.*
Brachionus Bakeri.
Cœlopus porcellus.
,, *tenuior.*
Colurus bicuspidatus.
,, *caudatus.*
Conochilus volvox.
Copeus caudatus.
,, *pachyurus.*
Diaschiza exigua.
Diglena ? uncinata.
Dinocharis pocillum.
,, *tetractis.*
Diplois propatula.
Euchlanis dilatata.
,, *triquetra.*
Floscularia campanulata.
,, *ornata.*
Furcularia forficula.
,, *longiseta.*
Mastigocerca bicornis.
,, *carinatus.*
,, *rattus.*
Melicerta ringens.
Metopidia oxysternum.
Monostyla cornuta.

Noteus quadricornis.
Notommata lacinulata.
Notops brachionus.
Œcistes crystallinus.
Philodina megalotrocha.
Polyarthra platyptera.
Proales parasita.
,, *petromyzon.*
Pterodina patina.
Rotifer macroceros.
,, *vulgaris.*
Sacculus viridis.
Salpina brevispina.
,, *mucronata.*
Stephanops lamellaris.
Synchæta pectinata.
,, *tremula.*
Triphylus lacustris.

CRUSTACEA. ENTOMOSTRACA.

Alona intermedia. New to Britain.
Alona quadrangularis.
Alonella excisa.
Bosmina longirostris.
Candona lactea.
Canthocamptus minutus.
Ceriodaphnia reticulata.
,, *rotunda.*
Chydorus sphæricus.
Cyclops phaleratus.
,, *serrulatus.*
,, *signatus.*
,, *tenuicornis.*
,, *Thomasi.* New to Britain.
,, *viridis.*
Cypria serena.
Cypridopsis vidua.
Daphnia hyalina. New to Britain.
Daphnia pulex.
Diaptomus ? gracilis.
Pleuroxus trigonellus.
,, *truncatus.*
Simocephalus vetulus.

INSECTA. DIPTERA.

Corethra plumicornis, Larva of.
Limnobium replicatum, Larva of.

Attendance: Eleven members of the Club and three members of other Societies. Total, 14.

September 27th.

OBJECTS FOUND ON THE EXCURSION TO GUNNERSBURY PARK.

PROTOZOA.

Condylostoma stagnale.
Dinobryon sertularia.

VERMES. ROTIFERA.

Anuræa brevispina.
,, *cochlearis.*
,, *tecta.*
Asplanchna Brightwellii.
Brachionus angularis.
,, *pala.*
,, *rubens.*
Mastigocerca bicornis.
Polyarthra platyptera.
Sacculus, sp.
Synchæta pectinata.
,, *tremula.*

Triarthra longiseta.
Daphnia mucronata.

CRUSTACEA. Entomostraca.
Bosmina longirostris.

Attendance: Twelve members of the Club and three members of other Societies. Total, 15.

Q.M.C. EXCURSIONS, 1891.

April 11th.

List of Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London, by Messrs. Grenfell, Parsons, Rousselet, and Scourfield.

PROTOZOA.
Anthophysa vegetans.
Archerina Boltoni.
Coleps hirtus.
Condylostoma stagnale.
Epistylis digitalis.
Euglena crypta (Grenfell), n.s.
Halteria (apparently n.s.).
Opercularia nutans.
Stentor polymorphus.
Trachelius ovum.
And a very large protomyxon, the central part measuring more than a quarter of an inch across.

VERMES. Rotifera.
Anuræa aculeata.
Asplanchna Brightwellii.
Brachionus angularis.
,, *Bakeri.*
,, *pala.*
,, *rubens.*
Floscularia campanulata.
ornata.
trilobata.
Limnias annulatus.
,, *ceratophylli.*
,, *cornuella.*
Monostyla lunaris.
Œcistes crystallinus.
,, *intermedius.*
,, *stygis.*
Polyarthra platyptera.
Pterodina patina.
Rotifer macrurus.
Stephanoceros Eichhornii.
Synchæta pectinata.
Taphrocampa annulosa.
Triarthra longiseta.

CRUSTACEA. Entomostraca.
Candona pubescens.
Canthocamptus minutus.
Chydorus sphæricus.
Cyclops phaleratus.
,, *Scourfieldii.*
,, *serrulatus.*
,, *tenuicornis.*
,, *Thomasi.*
,, *vicinus.*
Cypria opthalmica.

Cypria serena.
Cypridopsis vidua.
Ilyocryptus sordidus.
Simocephalus vetulus.

ARACHNIDA. Arctiscoнidæ.
Macrobiotus Hufelandii.

Attendance: Thirty-seven members of the Club, seventeen members of other Societies, and eleven visitors. Total, 65.

April 25th.

Objects Found on the Excursion to Snaresbrook, by Messrs. Parsons and Rousselet.

PROTOZOA.
Acineta mystacina.
Archerina Boltoni.
Bursaria truncatella.
Carchesium polypinum.
Dinobryon, sp.
Litonotus fasciola.
Pelomyxa, sp.
Spirostomum ambiguum.
Stentor niger.
,, *polymorphus*, green var.

VERMES. Rotifera.
Anuræa brevispina.
,, *serrulata.*
,, *tecta.*
,, sp., with one long and one short posterior spine.
Anuræa, sp., with one short posterior lateral spine.
Brachionus rubens.
Cœlopus brachyurus.
,, *cavia.*
Copeus labiatus.
Dinocharis tetractis.
Euchlanis triquetra.
Floscularia cornuta.
Furcularia longiseta.
,, *sphærica.*
Mastigocerca elongata.
Melicerta conifera.
Monostyla cornuta.
Notops brachionus.
,, *hyptopus.*
,, *minor* (Rousselet), n.s.
Œcistes crystallinus.
,, *intermedius.*
Pompholyx sulcata.
Polyarthra platyptera.
Rattulus cimolius.
Rotifer macrurus.
Sacculus viridis.
Stephanoceros Eichhornii.
Synchæta pectinata.
,, *tremula.*
Taphrocampa annulosa.
Triarthra longiseta.

ARACHNIDA. Arctiscoнidæ.
Macrobiotus Hufelandii.

INSECTA. Diptera.
Corethra plumicornis, larva of.

Attendance: Eleven members of the Club, three members of other Societies, and three visitors. Total, 17.

May 9th.

Objects Found on the Excursion to Hadley Wood, by Messrs. Oakden, Parsons, and Rousselet.

PROTOZOA.
Coleps hirtus.
Condylostoma stagnale.
Dinobryon sertularia.
Stentor niger.
VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*
,, *serrulata.*
,, *tecta.*
Asplanchna Brightwellii.
Brachionus angularis.
,, *pala.*
Cœlopus brachyurus.
Hydatina senta.
Noteus quadricornis.
Notholca acuminata.
Notops brachionus.
Polyarthra platyptera.
Rhinops vitrea.
Rotifer macrurus.
,, *vulgaris.*
Synchœta pectinata.
,, *tremula.*
,, sp., having two of the four coronal styles situated laterally, almost immediately over the auricles; small.
Triarthra longiseta.
CRUSTACEA. Entomostraca.
Bosmina lævis.
,, *longirostris.*
ARACHNIDA. Acarina.
Eylais extendens.
Hygrobates, sp.

Attendance: Seventeen members of the Club, five members of other Societies, and four visitors. Total, 26.

May 23rd.

Objects Found on the Excursion to Oxshott, by Messrs. Chapman, Parsons, Rousselet, and Western.

PROTOZOA.
Amphileptus anser.
Condylostoma stagnale.
Dinobryon sertularia.
Euglena acus.
Stentor polymorphus.
Vorticella chlorostigma.
VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*
,, *curvicornis.*
Anuræa serrulata.
,, *tecta.*
,, sp., with only one posterior lateral spine.
Anuræa, sp., with one long and one short posterior spine.
Brachionus angularis.
,, *pala.*
,, *rubens.*
,, *urceolaris.*

Cephalosiphon limnias.
Cœlopus brachyurus.
Conochilus volvox.
Copeus cerberus.
,, *pachyurus.*
Diaschiza, sp.
Dinocharis tetractis.
Eosphora aurita.
Euchlanis triquetra.
Floscularia cornuta.
,, *coronetta.*
,, *ornata.*
Furcularia ensifera.
Hydatina senta.
Limnias myriophilli (Western = *Limnoides myriophilli*, Tatem).
Mastigocerca bicornis.
Mastigocerca bicrisatta.
,, *carinata.*
,, *elongata.*
,, *rattus.*
Melicerta conifera.
,, *ringens.*
Notholca scapha.
Notommata saccigera.
Notops brachionus.
,, *hyptopus.*
Œcistes crystallinus.
Œcistes longicornis.
,, *pilula.*
Polyarthra platyptera.
Proales trigridia.
Pterodina patina.
Rattulus cimolius.
,, *sejunctipes.*
Rotifer macroceros.
,, *tardus.*
,, *vulgaris.*
Sacculus viridis.
Salpina macrantha.
,, *mucronata.*
Stephanops lamellaris.
,, *muticus.*
Synchæta pectinata.
,, *tremula.*
Triarthra longiseta.
Triphylus lacustris.

CRUSTACEA. Entomostraca.
Diaptomus castor.
Macrothrix laticornis.

ARACHNIDA. Arctiscoonidæ.
Macrobiotus Hufelandii.

MOLLUSCOIDA. Polyzoa.
Plumatella repens, recently hatched from statoblast.

Attendance: Six members of the Club, one member of the Hackney M. and N. H. Society, and two visitors. Total, 9.

June 6th.

Objects Found on the Excursion to Woking, by Messrs. Parsons and Rousselet.

PROTOZOA.
Amphileptus gigas.
Opercularia nutans.
Peridinium tabulatum.
Stentor niger.
,, *polymorphus.*
Stichotricha remex.
Trachelocerca olor.

Vaginicola crystallina.
Vorticella chlorostigma.
VERMES. Rotifera.
Anuræa aculeata.
,, *cochlearis.*
,, *curvicornis.*
Cœlopus brachyurus.
Conochilus volvox.
Copeus pachyurus.
Dinocharis pocillum, var.
Euchlanis parva (Rousselet), n.s.
Euchlanis triquetra.
Floscularia campanulata.
,, *cornuta.*
Floscularia coronetta.
Mastigocerca rattus.
Melicerta conifera.
,, *ringens.*
Notholca labis.
Notommato cyrtopus.
,, *lacinulata.*
Notops brachionus.
Œcistes brachiatus.
,, *crystallinus.*
,, *stygis.*
Philodina macrostyla.
Proales parasita.
Rotiſer macroceros.
,, *macrurus.*
Stephanoceros Eichhornii.
Synchæta pectinata.
,, small sp., same as found at Hadley.
Taphrocampa annulosa.
ARACHNIDA. Arctisconidæ.
Macrobiotus Hufelandii.

Attendance : Eleven members of the Club and one visitor. Total, 12.

June 20th.

Objects Found on the Excursion to Whitstable, by Messrs. Hembry and Waddington.

PROTOZOA.
Noctileuca miliaris.
PORIFERA.
Grantia.
Leucosolenia.
CŒLENTERATA. Hydrozoa.
Campanulina acuminata.
Campanularia.
Hydractinia echinata.
Sertularia.
Syncoryne.
Tubularia indivisa.
ECHINODERMATA.
Ophiocoma.
Spirorbis communis.
CRUSTACEA.
Maia squinado.
Pagurus Bernhardus.
Pycnogonum.
MOLLUSCOIDA. Polyzoa.
Amathia lendigera.
Crisia.
Flustra.
Membranipora.
Pedicellina Belgica.
Ophiura.
Solaster papposa.
VERMES.
Nereis.

Tunicata.
Ascidia virginea.
Cynthia.
Perophora Listeri.

MOLLUSCA. Gastropoda.
Eolis.
Trochus.

Attendance: Nineteen members of the Club, five members of other Societies, and two visitors. Total, 26.

July 4th.

Objects Found on the Excursion to Guildford, by Messrs. Chapman and Parsons.

PROTOZOA.
Anthophysa vegetans.
Stentor polymorphus.
Trachelius ovum.

PORIFERA.
Larval (planula) stage of a spongilla.

VERMES. Rotifera.
Anuræa brevispina.
Brachionus pala.
Dinops longipes.
Euchlanis deflexa.
Metopidia, sp.
Œcistes ptygura.
Polyarthra platyptera.
Pterodina patina.
Rotifer macrurus.

Attendance: Six members of the Club, two members of other Societies, and two visitors. Total, 10.

July 18th.

Objects Found on the Excursion to Staines, by Messrs. Burton, Chapman, Parsons, and Western.

PROTOZOA.
Anthophysa vegetans.
Arcella vulgaris.
Ceratium fusus.
Dimastigoaulax cornutum.
Dinobryon, sp., very branched and bushy.
Folliculina ? Boltoni.
Ophrydium sessile.
Peridinium tabulatum.
Phacus pleuronectes.
Raphidiophrys elegans.
Spirostomum ambiguum.
Stentor polymorphus.
Vorticella chlorostigma.

VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*
Brachionus Bakeri.
Copeus labiatus.
Dinocharis pocillum.
Diplois propatula.
Euchlanis dilatata.
,, *hyalina.*
,, *triquetra.*
Floscularia algicola.
,, *ambigua.*
,, *campanulata.*

Floscularia cornuta.
,, *longicaudata.*
Floscularia ornata.
,, *regalis.*
,, *trilobata.*
Furcularia forficula.
,, *longiseta.*
Mastigocerca bicornis.
Metopidia emarginata.
Microcodon clavus.
Monostyla bulla.
,, *rattus.*
Notommata saccigera.
,, *tuba* (Ehr.).
Œcistes crystallinus.
,, *longicornis.*
Œcistes mucicola.
Philodina aculeata.
Polyarthra platyptera.
Pompholyx sulcata.
Pterodina patina.
,, *reflexa.*
Rotifer macroceros.
,, *tardus.*
,, *vulgaris.*
Sacculus, sp.
Stephanoceros Eichhornii.
Stephanops lamellaris.
Taphrocampa annulosa.

INSECTA. Diptera.
Limnobium replicatum, larva of.

Attendance: Eight members of the Club and one visitor. Total, 9.

August 29th.

Objects Found on the Excursion to Richmond Park, by Messrs. Burton, Parsons, Rousselet, and Western.

CRYPTOGAMIA. *ALGÆ.*

Desmidiaceæ.
Closterium lunula.

Diatomaceæ.
Cocconema lanceolatum.
Diatoma vulgare.
Gomphonema acuminatum.

PROTOZOA.
Actinophrys sol.
Anthophysa vegetans.
Dinobryon sertularia.
Loxophyllum meleagris.
Ophrydium sessile.
Paramecium aurelia.
Pyxicola affinis.
Stylonichia mytilus.
Trachelocerca olor.
Vaginicola crystallina.
Vorticella chlorostigma.

VERMES. Rotifera.
Anuræa aculeata.
,, *brevispina.*
,, *cochlearis.*
Brachionus doreas.
,, *rubens.*
Cephalosiphon limnias.
Cælopus brachyurus.
Conochilus dossuarius.
Dinocharis pocillum.
Eosphora aurita.
Euchlanis dilatata.
,, *triquetra.*
Floscularia campanulata.
,, *cornuta.*
Limnias ceratophylli.
Mastigocerca bicornis.

Melicerta conifera.
,, *ringens.*
Notommata aurita.
Notops brachionus.
Œcistes crystallinus.
,, *mucicola.*
,, *ptygura.*
,, *stygis* (var.).
Pedalion mirum.
Philodina citrina.
Polyarthra platyptera.
Pterodina patina.
Rotifer vulgaris.
Salpina brevispina.
,, *spinigera.*
Scaridium longicaudum.
Stephanoceros Eichhornii.
Synchæta pectinata.
Taphrocampa annulosa.
,, *Saundersiæ.*
Dinops longipes was found in Richmond Park by Mr. Chapman, on October 4th.

OLIGOCHÆTA.
Œolosoma quaternarium.
Nais proboscidia.

MOLLUSCOIDA. POLYZOA.
Crystatella mucedo.
Plumatella repens.

Attendance: Eight members of the Club, three members of other Societies, and two visitors. Total, 13.

September 12th.

OBJECTS FOUND ON THE EXCURSION TO CHINGFORD, BY MESSRS. PARSONS, SCOURFIELD, AND WESTERN.

PROTOZOA.
Actinosphærium Eichhornii.
Amœba proteus.
Amphileptus gigas.
Arcella vulgaris.
Centropyxis aculeata.
Clathrulina elegans.
Difflugia acuminata.
,, *constricta.*
,, *pyriformis.*
Euglypha alveolata.
Stentor niger.
,, *polymorphus.*
Stylonichia mytilus.
Trachelocerca versatilis.

VERMES. ROTIFERA.
Anuræa aculeata.
,, *serrulata.*
,, sp., with one lateral posterior spine.
Anuræa tecta.
Brachionus Bakeri.
,, *urceolaris.*
Copeus pachyurus.
Dinocharis tetractis.
Diplois propatula.
Euchlanis dilatata.
Furcularia longiseta.
Mastigocera bicornis.
Notops brachionus.
Polyarthra platyptera.
Rotifer macrurus.
Salpina eustala.
,, *macrantha.*
,, *mucronata.*
Scaridium longicaudum.
Triphylus lacustris.

CRUSTACEA. ENTOMOSTRACA.
Alona guttata.

Alona intermedia.
Alonella excisa.
,, *nana.*
Bosmina longirostris.
Canthocamptus minutus.
Ceriodaphnia reticulata.
,, *rotunda.*
Chydorus sphæricus.
Cyclops serrulatus.
,, *signatus.*
,, *tenuicornis.*
Cyclops Thomasi.
,, *viridis.*
Cypria serena.
Cypridopsis vidua.
Daphnia pulex.
,, *hyalina.*
Diaptomus ? gracilis.
Pleuroxus trigonellus.
,, *truncatus.*
,, *uncinatus.*
Simocephalus vetulus.

Attendance: Ten members of the Club, three members of other Societies, and one visitor. Total, 14.

September 26th.

Objects Found on the Excursion to Hayes and Keston Commons, by Messrs. Parsons and Rousselet.

PROTOZOA.
Amphileptus flagellatus.
VERMES. Rotifera.
Anuræa cochlearis.
,, *serrulata.*
,, *tecta.*
Asplanchna priodonta.
Conochilus unicornis (Rousselet), n.s.
Dinocharis Collinsii.
Euchlanis parva.
Mastigocerca rattus.
Noteus quadricornis.
Pedalion mirum.
Philodina macrostyla.
Polyarthra platyptera.
Pompholyx sulcata.
Rotifer macroceros.
Salpina mucronata.
,, *spinigera.*
Stephanops chlæna.
Synchæta pectinata.

Attendance: Eight members of the Club and four members of other Societies. Total, 12.

October 10th.

Objects Found on the Excursion to Wood Street.

VERMES. Rotifera.
Adineta vaga.
Anuræa serrulata.
Brachionus urceolaris.
Callidina magna-calcarata, n.s.
Copeus pachyurus.
Pterodina cæca, n.s.
Sacculus viridis.
Synchæta tremula.

Attendance: Three members of the Club. Afternoon wet.

PROCEEDINGS.

December 4th, 1891.—Conversational Meeting.

The following objects were exhibited:—

Worms from fresh-water stream...	Mr. F. W. Andrew.
Mysis oculata...	Mr. E. T. Browne.
Amœba radulosa	Mr. W. Burton.
Spathe of *Iris germanica*	Mr. G. E. Mainland.
101 Diatoms, selected from cement-stein from Sendai, W. Japan	Mr. H. Morland.

December 18th, 1891.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club:—Mr. Alfred W. Jones, Mr. J. B. Bessell, Mr. G. C. Drew, Mr. Joseph Stevens, Mr. H. R. Arnold, Mr. A. M. Cheyne, Mr. H. S. Collins, and Mr. F. H. Evans.

The following additions to the Library and Cabinet were announced:—

"Proceedings of the Geologists' Association"	In Exchange.
"Proceedings of the Belgian Microscopical Society"... ...	"
"Proceedings of the New York Microscopical Society" ...	"
"Proceedings of the Canadian Institute"...	"
"The American Monthly Microscopical Journal"... ...	"
"The Botanical Gazette"	"
"Le Diatomiste"	"

Old work on Zoophytes, Pallas "*Elenchus zoophytum*" ...	Mr. Scherron.
Two sections of teeth	Mr. D. Caush.
Six slides—spicules of fish ...	Mr. F. M. Halford.

The thanks of the Club were voted to the donors.

Mr. Karop exhibited a microscope designed by Mr. T. T. Johnson, the chief point of novelty about which was the ingeniously contrived screw adjustment for focussing the sub-stage. He expressed a hope that a further improvement might be effected by doing away with the heavy foot and the spring-clips upon the stage.

The Chairman entirely agreed with Mr. Karop as to the extremely convenient form given to the substage movement before them; it was not only ingenious, but also likely to be very useful. He agreed also as to the stage clips, which had only one advantage, namely, the ease with which they could be taken out.

Mr. Karop said he should like to say a few words on one or two small matters, as the agenda paper was not very full that evening. Firstly, we may, as microscopists, be allowed without pedantry to take cognizance of trifling things, and accuracy even in non-essential concerns is desirable. Now English is a very elastic language, and we often have to incorporate terms for which we can find no equivalent ready to hand; to this, of course, there need be no objection. But latterly I have noticed a word, for the introduction of which, under correction, I think Mr. Nelson is responsible, and I see it has gained admission to the new edition of "Carpenter," and against its furthur use I would desire to raise a mild protest. I allude to the term *loup* or *loups*, used chiefly in connection with Steinheil's formula for aplanatic magnifiers, but also for other similar combinations. It is a French word, the German equivalent being *lupe*, plural *lupen*, and in both it applies to any hand or pocket magnifier, whether a single or compound lens, and therefore it should not be restricted to one or two combinations. But it is unnecessary. Why not speak of a Steinheil or other maker's triplet as we do of a Wollaston's doublet, or add "magnifier" to indicate the general use of such combination?

In reading the chapter on mounting in the new "Carpenter" I have come across two curious things which require notice,

although I trust I shall be exonerated from any desire to make pettifogging criticisms. The first is a note, on page 428, on the authority of Mr. Cole, who says alcohol is useless for hardening, *because of the water contained in it.* This is a very extraordinary statement, and I will make no further comment.

The second is one that has often been repeated in books, and may be very misleading. In treating of aqueous media for examination and preservation of specimens, on page 442, reference is made to "fruit juice." Now most ordinary people, on reading this bare statement, would think it meant the juice expressed from some succulent fruit, say plums. It is really a free and ignorant translation by Mr. Bolles Lee, "Microtomists' Vade-Mecum," of the German "frucht-wasser" or liquor amnii, the fluid in which the fœtus is suspended in its mother's womb; a material not easily obtained by the generality of microscopists. It would be equally accurate to recommend "eye-water," meaning thereby aqueous humour, which was formerly used for the same purpose.

Mr. E. M. Nelson said he entirely agreed with Mr. Karop as to the remarks he had made about the word "loup." He believed he was responsible for its introduction, having taken it from a catalogue and made use of it at a meeting in connection with a hand-lens. It was apt to be misleading, and should, therefore, be displaced by those which more accurately described the kind of lens or combination intended.

The Chairman said they all knew and respected Dr. Dallinger so thoroughly, that knowing also how well everything he undertook was sure to be done, any oversights, such as those mentioned, were likely to appear the greater by contrast. The special parts of the book which had been entirely written by Dr. Dallinger were so well done as to be almost beyond praise, and when they looked into the remainder it would be seen that the labour involved was almost too great for any one man, and, therefore, it was not surprising that other parts, which he did not write, did not come up to the same standard, that having to concentrate his attention upon the optical parts of the volume some other parts should have escaped the same careful treatment. Dr. Dallinger's extreme sensitiveness and unwillingness to trouble others had possibly prevented him from calling in the aid of those who were specialists in particular

branches, and no portion of the book showed the need of such assistance more than the chapter on mounting, so that a young microscopist would not be able to obtain from that chapter help which would enable him to mount an insect in a satisfactory way. There were few books, even of less technical character, of which it could be said that they were absolutely perfect, whilst with regard to this it would be freely admitted that those portions to which Dr. Dallinger had given personal attention were very admirably done.

Mr. H. Morland read a paper "On a Method of Mounting Diatoms," specimens of the metal discs mentioned being exhibited in illustration.

Mr. Hailes said he had used something very like this plan for some years in mounting Foraminifera, only instead of using metal he had found discs of paper or card to be best; they were easily punched out with a pair of shoemaker's pincers, and the materials could be obtained of any thickness. Balsam ran in quite freely, so that practically the card or paper disc was mounted in balsam with the object.

Mr. Morland said that his object in using metal was to know exactly the thickness between the cover and the slide. It was not merely for the sake of protecting the diatoms.

The Chairman said no doubt all who were in the habit of mounting objects were accustomed to use something to prevent the cover glasses from pressing upon delicate objects. He had himself sometimes used small glass beads for the purpose, but this was a very different matter from that aimed at by Mr. Morland, who wanted to get a substance of a certain definite thickness, and this not only kept off the pressure, but gave him an easy means of regulating the distance between the cover and the slip. He thought the suggestion would be of value to those who wanted to mount very minute flat objects for examination under very high powers. He had, however, been under the impression that gum or any other adhesive mixture was not advantageous and not necessary in mounting objects of this kind.

Mr. Morland said that some forms could be mounted very well without.

The thanks of the meeting were unanimously voted to Mr. Morland for his communication.

Announcements of meetings, etc., for the ensuing month were then made, and the meeting resolved itself into the usual conversazione, at which the following objects were exhibited:—

Melicerta tyro	Mr. F. W. Andrew.
Crystals of carbonate of lime from a horse	Mr. G. E. Mainland.
Triceratium Patagonicum	Mr. H. Morland.

JANUARY 1ST, 1892.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Nereis (Marine annelid)	Mr. E. T. Browne.
Dero	Mr. W. Burton.
Leaf of *Borago zeylandica*	Mr. G. E. Mainland.
Tubercle Bacilli, from a Frog ...	Mr. C. J. Pound.
Tinoporus baculatus	Mr. J. J. Vezey.

JANUARY 15TH, 1892.—ORDINARY MEETING.

A. D. MICHAEL, Esq., F.L.S., F.R.M.S., etc., Vice-President, in the Chair.

The Chairman said he regretted very much to have to announce that their Secretary, Mr. Karop, was laid up with the prevailing epidemic, and, therefore, unable to be in his place that evening. They would be glad to hear that he was progressing favourably, though he would not, perhaps, be able to go out for two or three weeks. Mr. Hailes had kindly undertaken the duties of Secretary meanwhile.

Mr. Hailes then read the minutes of the preceding meeting, which were duly confirmed and signed by the Chairman.

The following gentlemen were balloted for and duly elected Members of the Club:—Veterinary Captain Rutherford, Mr. W. H. Maw, M. Gustave Goffi, Mr. Wm. J. Pierce, Mr. Chas. D. Soar, Mr. David Bryce, Mr. James Mare, jun., and Mr. H. S. Hogan.

The following additions to the Library were announced:—

"Proceedings of the Essex Natural History Society"...	In Exchange.

"Annual Report of the Brighton and Sussex Natural History Society"	In Exchange.
"The Microscope"	"
"The Botanical Gazette"	"
"Science Gossip"	"
"The American Monthly Microscopical Journal"	"
"The American Naturalist"	"
"Annals of Natural History"	Purchased.
"Grevillea"	"

The Chairman reminded the Members present that by the death of Cardinal Manning on the previous day the Quekett Club had lost a member of nearly twenty years' standing. He attended their Annual Meeting on July 26th, 1872, to hear the Presidential Address, then delivered by Dr. Lionel S. Beale, and was so much interested in the proceedings that he expressed a desire to become a Member. He was accordingly nominated at the following meeting, and elected at the Ordinary Meeting, Sept. 27th, 1872. Though not familiar to them as an attendant at their meetings, nor distinguished amongst them as a microscopist, there could be no doubt that by his death one of the most distinguished names had been removed from their list of Members.

The Chairman said it was also a matter for regret that Dr. Dallinger's health prevented him from being present with them that evening; he believed there was nothing serious the matter, but he was under the necessity of taking care not to expose himself to any chill. He had, however, written to express his further regret that an engagement of old standing would prevent him from being present also at their next meeting to deliver the customary Annual Address, and under these circumstances he asked their permission to postpone the delivery of that address until the meeting in March. They could not, of course, postpone the Annual Meeting, so that on February 19th the ordinary business of the Annual Meeting would be proceeded with as usual, but papers would be taken afterwards instead of the President's Address.

In preparation for the Annual Meeting, the Chairman said it would be necessary to appoint two gentlemen to serve as Auditors of the accounts of the past year. The Committee

had nominated Mr. Hainworth to act on their behalf, and it now remained for the Members present to elect another gentleman to represent them as Auditor.

Mr. J. Terry was then proposed as Auditor by Mr. Chapman, seconded by Mr. Waller, and duly elected.

The Chairman said their next business was to nominate gentlemen to fill the vacancies caused upon the Committee by the retirement by rotation of Messrs. Morland, Dadswell, Reeves, and Rousselet, and by the removal of Mr. Vezey to the office of Treasurer. The four retiring Members were, of course, eligible for re-election.

The following gentlemen were then nominated as candidates for the five vacancies mentioned:—

Mr. G. E. Mainland, nominated by Mr. Freeman and seconded by Mr. Hardy.

Mr. H. Morland, nominated by Mr. Allen and seconded by Mr. Burton.

Mr. E. Dadswell, nominated by Mr. Chapman and seconded by Mr. Brown.

Mr. W. W. Reeves, nominated by Mr. Ward and seconded by Mr. Newton.

Mr. E. T. Newton, nominated by Mr. Reed and seconded by Mr. Waller.

Mr. C. Rousselet, nominated by Mr. Western and seconded by Mr. Pound.

Mr. J. G. Waller, nominated by Mr. Nelson and seconded by Mr. Morland.

Mr. J. W. Burton, nominated by Mr. A. Smith and seconded by Mr. Freeman.

Mr. Bryce read a paper " On some New Rotifers of the genus Callidina," illustrating the subject by drawings on paper, and enlarged on the blackboard, and by specimens shown under the microscope.

The Chairman said that the Members of the Club had been so active and fortunate amongst the Rotifers, that this paper could not fail to interest many who, he hoped, would add some remarks upon the subject.

Mr. Western regretted that he had nothing to add to the description given, but he wished to say that in his opinion the paper to which they had just listened was a very valuable con-

tribution to the life history of a little studied genus. He had not much studied it himself, because its habitat differed from those of the ordinary Rotifers; but having had some specimens given to him he had found them very interesting.

The Chairman hoped they would have been favoured with more remarks from Members present upon this paper, which opened up a subject of the very highest interest, and one which was well worthy of being worked out. The paper itself was not only a carefully-considered description of the group, but it also opened up a question of symbiosis, a subject in itself at present very imperfectly understood, but, nevertheless, one of great importance and interest. As dealing with the actual life history of these Rotifers, the paper was also one of very great interest and importance.

Mr. E. T. Newton said he should be glad to hear in what way this symbiosis was considered to be beneficial to the plant, and also if the apertures described were natural to the moss, or were made by the Rotifers.

Mr. Bryce thanked the members of the Club for the kind way in which they had received his communication. As regarded the idea of symbiosis, Dr. Zelinka had drawn attention to it, but so far it would seem to rest very much upon supposition. The suggestion was made that it might be of benefit to the plant on account of the destruction of spores by the Rotifers, especially those of *Nostoc*, which could, if not removed, be very injurious to the plant. The Rotifers lodging in the cavities would eat up the spores of the *Nostoc* as soon as they appeared, and so prevent the mischief which their development would occasion. As regarded the apertures in the sphagnum cells, it would seem that these were entirely natural, as indeed might be seen if the specimens exhibited under the microscope in the room were examined.

Mr. R. T. Lewis read a "Note on a Species of Ixodes found on a South African Lizard," the subject being illustrated by specimens shown under the microscope, as well as by coloured drawings and diagrams.

The Chairman said that as this subject was connected with the Acarina he should no doubt be expected to say something about it. It was by no means an easy job to identify Ticks, because the information concerning them was very much scattered, and the bulk was not at all easily accessible. He would, therefore,

be a rather bold individual who would say that any distinctively marked specimen which he found was a new species. Ixodidæ from Lizards had been described on many occasions; they were mentioned by Lucas, whose great work on the "Natural History of Algeria" was remarkably complete, although his descriptions of Ixodidæ were not equal to his other subjects. The homologies of the rostrum and mouth-organs were more or less understood, but not so well perhaps as they might be if the comparisons were less often made to the mouth-organs of insects instead of to those of the Arachnida. Mr. Lewis was perfectly right in saying that the larger number of writers upon the subject have called that portion which carries the barbs the labium, and in many other groups the same kind of use is made of the term. But, for all that, the use of this term conveyed an entirely false idea, because the organ was not the homologue of the labium of an insect. It was really a maxillary lip formed by the fusion of the maxillæ; they were completely fused together at the base, and although they thus formed a kind of lip it was certainly a maxillary lip. Its position and homology was defined clearly by the palpi which were annexed to it, because these were the maxillary palpi, and certainly not labial palpi. In the same manner it had been asserted that the first pair of legs really represented the labial palpi, thereby accounting for the fact that whereas insects proper had only six legs these creatures had eight. This supposition seemed rather taking at first, but it was negatived by the fact that in the immature stages there were only three pairs of legs, and that it was only at a later stage that the fourth pair appeared, and when they did so they were found to be abdominal, and not belonging to the Cephalothorax at all. The question as to there being two pairs of mandibles had also been raised before by Haller and others. He asserted that there were two pair of mandibles. Fustenberg also held that there were two pairs, but all the analogies of the subject were strongly against it, although there might be one pair of mandibles and one pair of something else beside. The sheath was more or less common in many groups of Acarina, but it did not assume the same form as in the Ixodidæ. With regard to the remarks made as to the inconvenience produced by the attacks of Ixodes, so far from their being in any way exaggerated, he could only say that they were far below the

mark, for so great was the damage done and trouble occasioned by them in hot climates, especially in the West Indies, that there the inhabitants were inquiring whether some Government aid could not be given to assist them in dealing with the mischief, or in ascertaining some means of doing so. Of course, as Mr. Lewis had mentioned, a great deal of the trouble which arose in the case of these bites was due to the rostrum getting broken off in the wound. Animals would be likely to scratch the Ticks off, and persons would pull them off roughly when they felt themselves bitten, so that there would be in most cases portions left behind. If they examined the specimens of Ixodidæ sent home to this country they would find that in nine cases out of ten the rostrum was broken off. The sucking powers of these creatures were very remarkable, but he did not think that the muscular distension of the abdomen was the means by which the suction was produced; the sucking organ was probably the pharynx, and the abdomen was merely the receptacle into which the blood was passed. The pharynx was furnished with a remarkable set of muscles, which enabled it to act like a powerful force pump. Measurements of Ticks were of very little use unless you knew whether the individuals were full fed or not, because so great were their powers of distension that a creature which when empty was no larger than a grain of mustard seed would when gorged swell up to the size of a person's thumb-nail. Prof. Leidy was so struck with this remarkable distension that he took the trouble to weigh some of the individuals before and after they had been feeding, and he found that in some instances they weighed nearly 100 times as much when full fed as they did before they began. He might mention also that latterly the Ixodidæ had been divided up into many genera, so that now the word Ixodes was used in a very restricted sense, as compared with its application many years ago.

Mr. Western said he could quite corroborate what had been said as to the enormous increase in the size of these creatures after sucking blood, and also as to the amount of mischief they did by their attacks. In the East Indies their enormous numbers made them a source of great annoyance, and from the considerable amount of irritation set up they caused various diseases amongst animals, not only by the bites themselves,

but by their worrying effects. He had kept dogs, and had found them sometimes with their ears stuffed completely full of these Ticks.

Announcements for the ensuing month were then made, and the meeting terminated with the usual conversazione, the following objects being exhibited:—

Callidina reclusa, in sphagnum cell ...	Mr. D. Bryce.
Callidina lata	" "
Photo of Moon	Mr. J. D. Hardy.
Ixodes from African Lizard, and mouth-organs of same ...	Mr. R. T. Lewis.
Triceratium divisum	Mr. H. Morland.
Cocci of Pneumonia	Mr. C. J. Pound.

FEBRUARY 5TH, 1892.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Fredericella sultana	Mr. F. W. Andrew.
Teeth of Dogfish, *Scyllium canicula*...	Mr. E. T. Browne.
Triceratium constans	Mr. H. Morland.

FEBRUARY 19TH, 1892.—TWENTY-SIXTH ANNUAL MEETING.

A. D. MICHAEL, Esq., F.L.S., F.R.M.S., etc., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club:—Mr. Thos. A. G. Powell, Mr. Washington R. Brook, Mr. John Albany, Mr. W. E. Samson, Mr. W. H. Brown, Mr. Lewis Wright, Mr. W. G. Rumbold, Mr. Henry M. Bernard, Mr. Henry Burgess, and Mr. Herbert Snelling.

The following additions to the Library were announced, and thanks voted to the donors:—

"The Botanical Gazette"	In Exchange.
"The Monthly Microscopical Journal" ...	"
"Proceedings of the Royal Society" ...	"
"Report of the Leeuwenhoek Club" ...	"
"The Microscope"	"

"Journal of the New York Microscopical Society"	In Exchange.
"Journal of the Royal Microscopical Society"	"
"Proceedings of the Scientific Society of Manitoba"	"
"Transactions of the Natural History Society of Kieff"	"
"Annals of Natural History"	Purchased.
"Quarterly Journal of Microscopical Science"	"

The Secretary having remarked that this annual meeting was the 300th meeting of the Club,

The Chairman appointed Mr. Chapman and Mr. J. M. Allen to act as Scrutineers, and the ballot for Officers and Committee for the ensuing year was proceeded with.

Mr. Karop called attention to the fact that the name of Mr. W. W. Reeves had been erased from the list of Members nominated to fill the vacancies on the Committee at the last meeting. The Members would, he felt sure, deeply regret to hear that, since that meeting, Mr. Reeves had become so seriously ill that there appeared to be no hope of his being able to discharge the duties if elected, so that his name had consequently been withdrawn.

The Chairman then called upon the Secretary to read the 26th Annual Report of the Club.

The Treasurer's Annual Statement of Accounts and duly-audited Balance Sheet were read by Mr. Vezey.

Mr. J. M. Allen moved, and Mr. B. W. Priest seconded the proposal, "That the Reports now read be received and adopted, and that they be printed and circulated in the usual way."—Carried unanimously.

The Chairman said it would no doubt be noticed from the Report that the very successful exhibition meeting held last year was paid for, not out of the funds of the Society, but by private subscriptions of certain of the Members. It was felt by many that it would be a very pleasant thing if they could have another meeting of the same character, but as one result of their moving to Hanover Square, added to the cost of the Journal, was to leave them very little to spend in the

direction of entertainments, it was proposed to defray the cost of this special meeting in a similar way to the last. As there were doubtless many Members who would be glad to contribute something towards this object, it was suggested that they should put themselves in communication with Mr. Parsons, who would be very pleased to receive subscriptions for the purpose. There was no limit set as to the smallness of the sums to be given, and whether anything was given or not was of course a purely optional matter.

The Scrutineers at this point having handed in their Report as to the result of the ballot, it was announced by the Chairman that the whole of the Officers named on the list had been elected; and that the five following Members had been elected to fill the vacancies on the Committee:—Messrs. Mainland, Morland, Dadswell, Waller, and Rousselet.

It was then moved by Mr. C. West, seconded by Mr. Goodwin, and unanimously resolved, "That the best thanks of the Club be given to the Auditors and Scrutineers for their services."

Mr. J. G. Waller said he had the very pleasant duty to perform of proposing "That their hearty thanks be given to the Officers and Committee of the Club for their services during the past year." He might, if it were necessary, say a great deal in support of this motion, but he felt sure that all knew how well deserved these thanks were, and they would doubtless agree with him that there was not a better served Society in this respect than the "Quekett."

The motion, having been seconded by Mr. Chapman, was put to the meeting and carried by acclamation.

Mr. Karop, in acknowledging the vote of thanks, assured the Members that so far as he was concerned, and he was quite sure that it was the case of his brother officers also, the duties undertaken on behalf of the Club were nothing but a pleasure.

Mr. Vezey also thanked the members for the honour done to him by his election as their Treasurer, and expressed a hope that he might be able as faithfully to perform the duties as his predecessor, Mr. Gay, had done.

The Chairman said they would remember that it was announced at their last meeting that owing to an engagement of long standing Dr. Dallinger would be unable to be present at the Annual Meeting, and that his annual address would in consequence be postponed to the Ordinary Meeting in March.

Mr. Buffham read a paper "On a New Marine Chantransia," illustrated by drawings upon the blackboard; also a paper "On the Conjugation of a Marine Diatom," *Orthoneis binotata*, Grunow, illustrated by diagrams and drawings.

Mr. Morland felt sure the members would feel greatly obliged to Mr. Buffham for his very interesting communication. He could himself add nothing to what had been said, these "horns" being entirely new to him as matters of observation, nor did he know that they had been seen before in the conjugation of diatoms.

Mr. Karop also expressed the indebtedness of the Club to Mr. Buffham for his communication. He seemed to be at present the only member who took up the study of diatoms with the idea of investigating their life history and processes of reproduction. If only some of the time and skill spent in the examination of the markings could be devoted to the line pursued by Mr. Buffham very valuable results might be expected. As to these horns, he could not think that they were simply for purposes of protection, because other diatoms had not got them, and he also thought that if these gelatinous filaments were protective they would be more frequently found. The observations appeared to be extremely valuable, and they were greatly indebted to Mr. Buffham for the description he had given.

The Chairman said their thanks were due to Mr. Buffham for his most interesting paper. It was always a pleasure to hear him speak upon the subject of the sexual processes of the Floridæ, on which he was an authority. He had much pleasure, therefore, in moving a cordial vote of thanks for his communication.—Carried *nem. dis.*

Mr. Buffham said he was much obliged to the members for the cordial way in which his paper had been received. If he had conveyed the impression that the horns were something simply belonging to this conjugating form, he should like to correct it, because the vegetative diatom also showed the peculiarity. This observation was not new, as Grunow mentioned having found them. With regard to their apparently breaking up into smaller forms, he thought there might possibly be sometimes a little colony attached to the valve, and in cases of conjugation he always thought it advisable to see if there were any vegetative as well as sporangial frustules. In as many as 42 cases out of 46 he had found these horns present.

The Secretary said they had received a communication from Mr. Nelson "On a Simple Method of Finding the Refractive Index of Mounting Media," but owing to the lateness of the hour it was decided that this should be taken as read.

Announcements for the ensuing month were then made. The attention of Members was called to the fact that as the third Friday in April would be Good Friday the Ordinary Meeting for that month would have to be omitted, and the meeting terminated with the usual conversazione, the following objects being exhibited by Mr. Buffham:—

Chantransia trifolia, n.s., with monospores, and *Orthoneis binotata*, on *Calothrix confervicola*.

March 4th, 1892.—Conversational Meeting.

The following objects were exhibited:—

Æolosoma quaternarium	Mr. F. W. Andrew.
Head of *Nereis*	Mr. E. T. Browne.
Foraminifera from Jersey	Mr. G. E. Mainland.
Eunotogramma productum	Mr. H. Morland.
Sponge, *Sannginella pupa*	Mr. B. W. Priest.
Macrotrachela papillosa	Mr. P. Thompson.

March 18th, 1892.—Ordinary Meeting.

Dr. W. H. Dallinger, F.R.S., F.R.M.S., etc., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club:—Mr. John H. Tallent, Mr. T. F. Black, Mr. W. H. Brown, Rev. E. P. Marriott, Mr. C. G. Seligmann, Mr. John Elliott, Mr. Frederick M. Halford, and Mr. J. A. Daniell.

The following donations were announced:—

"Science Gossip"	In Exchange.
"The American Monthly Microscopical Journal"	"
"The Botanical Gazette"	"
"Le Diatomiste"	"
"Proceedings of the Royal Society" ...	"

"Paper on a New Marine Alga" ... ... The Author.
"Annals of Natural History" ... ... Purchased.

Mr. Morland exhibited one of Brown and Sharpe's American wire gauges, which he thought would be found very useful as affording an easy means of ascertaining the thickness of cover glasses. Measurements could quickly and easily be made down to the $\frac{1}{1000}$th of an inch. The gauge was handed round for inspection.

Mr. R. T. Lewis said as this subject had been brought forward he might again mention Trotter's patent gauge as being also available for the same purpose. This was made of steel, and being only two inches long was easily carried in the waistcoat pocket. Its construction was very ingenious, and by means of two sliding scales on the Vernier principle it showed six measurements at the same time, *i.e.*, the English standard wire gauge with its equivalents in decimals of an inch and of a millimetre were shown on one face, and on the other, for the use of electricians and others, the sectional area of the round wire in fractional parts of a square inch, the weight of copper wire per 100 feet, and the quantity of current it would theoretically carry. It required something of an education to be able to use it with facility, but, like most other things, when you knew how to use it the process was simple.

Mr. J. E. Ingpen said the only difficulty he saw as to the use of these gauges was that there was likely to be a difference in the results according to the amount of pressure applied. This he could not help thinking was a point rather against all micrometer gauges which worked by touch, because in the measurement of cover glasses it was specially necessary to be very exact.

The President said they would all recognize the desirability of being able to ascertain the thickness of cover glasses, and would therefore welcome any plan which would facilitate it. They were much indebted to Mr. Morland for bringing this little instrument before them.

The President then read his Annual Address, postponed from the last meeting for the reason then named.

Mr. A. D. Michael thought that after the way in which it had been received it was scarcely necessary for him to ask for an expression of their thanks for the highly instructive address to which they had just listened, not the least valuable part of

which was its eminently suggestive character. With regard to the fear that in the future there might be danger that amateur work might be thrown aside by the increased demands of professional work, he thought no men were more alive to such a danger than were the specialists themselves. But he thought he might say, that although the high conditions required by special work made this at the present time a special danger, yet it could not be denied that, in this country at least, some of the best biological work had been done by amateurs, and it would be a bad day for science in this country when the amateur biologist ceased to take the same interest in this kind of work as he had done in the past, and thus ceased to supply material facts for others to utilize. They did not need any better illustration of the value of the work of the amateur biologist than was furnished by the work accomplished by their President himself, and he felt sure that the remarks which had fallen from him that evening were such as all would do well to consider deeply. If anyone would take up the influenza question, for instance, and could carry out investigations with some hope of success, it would be a matter of great importance to science, as well as to those who were sufferers from it. Unfortunately the popular idea at the present time might be summed up by the statement that they did not see in what way matters had been helped by scientific men telling them that they had a microscopic worm in their organisms which caused all the mischief, if they could not at the same time tell them how it got in, or how to get it out again. He had great pleasure in moving that the best thanks of the Club be given to the President for his admirable address.

Mr. G. E. Mainland had great pleasure in seconding the motion.

Mr. Michael having put the motion to the meeting, declared it to be carried by acclamation.

The President said he felt much indebted to the Members of the Club for the cordial and kind expression of feeling as shown by the manner in which this resolution had been passed. It had given him great pleasure to be associated with the Club, and though his derelictions had been more frequent than he could have wished, they had been so generously condoned that he felt it both an honour and a pleasure to have again given him the opportunity of occupying the chair for another year.

Announcements of meetings for the ensuing month were then made, special attention being called to the exhibition meeting arranged for May 5th, at Freemasons' Tavern, and the proceedings terminated with the usual conversazione, the following objects being exhibited:—

Chætophora elegans	Mr. F. W. Andrew.
Triceratium Grayii	Mr. H. Morland.

April 1st, 1892.—Conversational Meeting.

The following objects were exhibited:—

Cristatella mucedo	Mr. F. W. Andrew.
Asterina gibbosa	Mr. E. T. Browne.
Asilius sulcatus	Mr. W. Burton.
Sections of Head of Minnow ...	Mr. H. E. Freeman.
Aulacodiscus excavatus (type slide of 121 specimens) ...	Mr. H. Morland.

May 5th, 1892.—Special Exhibition Meeting.

A special meeting was held on the above date for the exhibition of instruments and microscopical objects. The meeting was, as last year, held at Freemasons' Tavern, on account of the better accommodation afforded, and was attended by a large number of Members and their friends, about 800 being present. The following objects were exhibited:—

Mr. W. Addis	Skin from Rat's Tail.
Mr. F. W. Andrew	Young *Cristatella mucedo*, Seeds of *Pawlonia*, and Plant Hairs.
Mr. A. T. Ashe	*Arachnoidiscus* on Coralline.
Mr. C. Baker ...	Diatoms with Zeiss's and Reichart's Apochromatic Object Glasses, Desmids with Zeiss's Apochromatic O.G., and Leaf with Hairs.
Mr. F. W. Baxter ...	Pollen of Mallow.
Mr. W. E. Baxter ...	*Asteromphalus stellaris*.
Messrs. R. and J. Beck	*Lophopus cristallinus*, *Rhinops vitrea*, Tongue of Blowfly, Polycistina, Shells from Chalk, and Influenza Bacillus.
Mr. W. A. Bevington	Young Oysters, Antenna of Moth, and Gizzard of Cricket.

Mr. W. B. Bradford	...	*Spirogyra* in conjugation.
Mr. A. J. Brown	...	Eggs and Larva of Moth.
Mr. E. T. Browne	...	Sting of Wasp.
Mr. D. Bryce ...	...	*Œcistes cristallinus.*
Mr. W. Burton ...	...	*Cristatella mucedo*, and Rotifers.
Mr. A. L. Corbett	...	Sulphate of Quinine.
Mr. E. Dadswell		*Stephanoceros Eichhornii*, and Desmids.
Mr. A. Dean ...		Palate of Limpet, and Leaf of Thyme.
Mr. J. Dick ...	...	Proboscis of Blowfly.
Mr. C. Dunning...		Sponge, *Myerina claviformis*, and Zoophyte, *Plumularia setaceæ.*
Mr. A. Earland ...		Selected Foraminifera, from Philippine Islands, young Starfish, and Butterflies' Eggs.
Mr. T. D. Esser ...	...	Head of Humble Bee.
Mr. W. W. Fletcher		Wing of Butterfly and Leg of Diamond Beetle.
Mr. H. E. Freeman		Exuvia of Plant Insect, and casts of Foraminifera from Colon.
Mr. G. N. Fryer		Blood circulation in Tadpole, Head of Hunting Spider, and Tongue of Bee.
Mr. W. Goodwin		*Pennaria calicandina, campanularia*, and *Siphonia.*
Mr. H. F. Hailes		Foraminifera (selected) from King George's Sound.
Rev. J. Halsey ...	...	Young *Polynœ.*
Mr. J. D. Hardy		Hairs of *Verbascum thapsus*, Lingual Ribbons of *Cyclostoma elegans*, and *Helix aspera*, Trachea of Larva of *Dytiscus*, Spicules of Sponge, *Asterina gibbosa* and *Volvox stellatus.*
Mr. G. Hind ...		Head of Larva of *Corethra plumicornis* and *Stephanoceros Eichhornii.*
Mr. F. W. Hembry		*Hydra viridis*, and Larva of *Cheironimus.*

Mr. J. E. Ingpen	Section of Broom Twig, Stellate Hairs Agate, and Crystals of *Platino-cyanide* of Yttrium.
Mr. E. K. Jaques ...	Echinus Spines (sections).
Mr. A. J. Jenkins	Cyclosis in *Vallisneria spiralis*, *Melicerta ringens*, *Stentors*, Ciliary Action in Gill of Mussel, etc.
Mr. W. Johnson	Grouped Diatoms, Spicules of *Synapta*, *Bacillus anthrasis*, *Filaria sanguinis hominis*, etc.
Mr. J. W. Lasham ...	Grouped Sponge Spicules.
Mr. R. T. Lewis	Larva of South African Cattle Tick, *Amblyomma Hebræum*.
Mr. C. J. Machin ...	*Hydatina senta*.
Mr. G. E. Mainland	*Lamium purpureum*, and *Aspidiotus conchiformis* from an Apple.
Mr. H. Morland...	Seconds hand of Watch seen through a Beetle's Eye.
Mr. E. T. Newton	Section of Eye of Lobster, and section of Coal.
Mr. F. A. Parsons ...	*Penneria cavalina*.
Messrs. Powell and Lealand ...	Cyclosis in *Vallisneria*.
Mr. J. W. Reed... ...	Section of Stem of *Fagus cuprea*.
Mr. F. Reeve ...	New Zealand Moss, *Taxodura*, and spores of Haresfoot Fern.
Mr. C. Rousselet ...	Rotifers.
Mr. James Russell ...	Diatoms and Stentor.
Mr. W. E. Samson ...	Polycistina and Oak Buttons.
Mr. D. J. Scourfield ...	*Argulus foliaceous*.
Mr. W. A. Skipper ...	Circulation in Tail of Tadpole.
Mr. J. Slade	Section of Fruit of Mallow.
Mr. W. Smart ...	Section of Human Lung, injected, and Feather of Goldfinch.
Mr. C. D. Soar	Diatoms from St. Peter's, Hungary.
Mr. A. T. Spriggs ...	*Asplenium adiantum nigrum*.
Mr. J. H. Steward	Parasite of Flying Fox, Sting of Wasp, section of Blue Gum Tree, Geranium Aphis, etc.
Mr. A. W. Stokes ...	*Batrachospermum moniliforme*.

Messrs. J. Swift and Son	Section of Granite, Spines of Star-fish, Tongue of Fly, Sting of Hornet, Grouped Polycistina, etc.
Mr. J. J. Vezey	Frond of Fern, *Davallia canariense.*
Messrs. W. Watson and Sons	Trinidad Spider, Influenza Bacillus, Diatomaceæ, Eggs of Butterflies, Section of Drone Fly's Eye, Fertile Seed of Sugar Cane, etc.
Mr. J. C. Webb	Polycistina.
Mr. C. West ...	Larva of *Corethra plumicornis*, and Head of Sand Wasp.
Mr. H. E. White ...	*Fredericella Sultana.*

By the kind efforts of Mr. J. W. Reed, the assistance of a very efficient amateur band was obtained, and a choice selection of music was performed during the evening by the following ladies and gentlemen :—

Mr. C. Bailey	Conductor.
Mr. Fenigstein, Miss Druitt, Miss Louisa Grant, Mr. E. Booth, Dr. Leonard Guthrie, Mr. Nicholson, Mr. J. Swale	Violins.
Mr. Walter Goss, Mr. Quarrell	Violas.
Miss E. Houghton, Dr. Leonard Grant ...	Violoncellos.
Miss Houghton, Dr. Dundas Grant ...	Double basses.
Mr. George Goss	Flute.
Mr. Cressall, Mr. Price	Clarionettes.
Mr. Garrett	Bassoon.
Mr. Blandford	Horn.
Mr. Woodhouse	Cornet.
Mr. P. Booth	Trombone.
Mr. Marmaduke Reed	Euphonium.
Mr. Dyer	Tympani.
Mrs. Dundas Grant	Pianoforte.

MAY 6TH, 1892.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Plant hairs, *Anagallus tenella* ...	Mr. F. W. Andrew.
Cristatella mucedo	Mr. W. Burton.
Scoliopleura tumida	Mr. H. Morland.
Copeus labiatus	Mr. C. Rousselet.

May 20th, 1892.—Ordinary Meeting.

Dr. W. H. Dallinger, F.R.S., F.R.M.S., etc., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club:—Mr. Charles Young, Mr. A. J. Sargeant, and Mr. John Robinson.

The following donations were announced, and the thanks of the Club were voted to the donors:—

"Reports of the Smithsonian Institution"	In Exchange.
"Transactions of the Zoological Society of France"	"
"Journal of the Royal Microscopical Society"	"
"Proceedings of the Royal Society" ...	"
"International Journal of Microscopy" ...	"
"The Botanical Gazette"	"
"The Microscope"	"
"Proceedings of the New York Microscopical Society"	"
"The American Monthly Microscopical Journal"	"
"The Essex Naturalist"	"
"Report of the Essex Field Club" ...	"
"Proceedings of the Literary and Philosophical Society of Manchester"	"
"Proceedings of the Natural History Society of Manitoba"... ...	"
"Proceedings of the Royal Cornwall Society"	"
"Report of the U.S.A. National Museum"	"
"Report and Proceedings of the Ealing Microscopical Society" ...	"
"Methods and Formulæ for Staining Microscopical Preparations and Bacteria," etc., by J. W. Squire	The Author.
One Slide—Larvæ of Cattle Tick... ...	Mr. R. T. Lewis.

Mr. Karop said he had received from Colonel O'Hara a box

containing seven slides, which he thought were of some exceptional interest and had asked that they might be examined and reported upon. Three of these were sections of the flesh of a fowl, which was said to have turned black, and to exhibit traces of disease, as if from the attacks of some nematode worm. The only thing he could make out of this was that the flesh was in a putrid condition, the pressure used in mounting had separated the muscular fibres, and these spaces seemed to have been mistaken for the tracks of worms. Two slides of liver of a bat were also supposed by Colonel O'Hara to exhibit some diseased condition, but, to his mind, they appeared to be perfectly healthy, and to present no uncommon appearance. One of pine wood was not specially remarkable, neither was that of "Hairy Tumour from Horse." Colonel O'Hara said, in his letter, that he wished to have those of the fowl returned, the others he placed at the disposal of the Club.

They had also received a letter from Mr. Ash, accompanied by a sample of soil from Guatemala which was said to be very rich in diatoms. An examination of this showed it to be of a nature precisely resembling what was known as "Diatomite" from the dried beds of the old Scotch Lochs. It contained abundance of well-known freshwater forms. The quantity sent by Mr. Ash was for distribution amongst the Members, and if more was required it could be had in any quantity.

Mr. Scourfield read a paper on "Some New British Cladocera," illustrating the subject by drawings upon the blackboard.

The President said they were greatly obliged to Mr. Scourfield for this very interesting and useful communication. It was certainly a curious feature in the history of the Club that the Entomostraca seemed to have been entirely passed over, perhaps—as was the case in other directions—because they were so plentiful, they had been regarded as of little value as objects of study. And yet it would seem that though there had been men who had brought the energies of a lifetime to bear upon these organisms, there were details which had been overlooked, and which therefore offered a promising field to those who were disposed to investigate it. This was a matter of importance at a time when it seemed certain that species as at present constituted must largely go.

Mr. Karop said it was certainly very curious to find that they had never before had a paper on Entomostraca. When this was mentioned to him he hardly credited the statement, but having looked through the volumes of their "Proceedings," he was obliged to come to the conclusion that such was the case.

Mr. E. M. Nelson gave at some length a *resumé* of his paper on "The Optical Principles of Binoculars," dealing especially with the apparent conflict of the opinions of Dr. Carpenter and Prof. Abbe upon the subject.

The President said they were greatly indebted to Mr. Nelson for this paper. He should not like, however, to express any extended opinion upon it, because they had not heard it read in its complete form, but he was quite sure that when they had it before them they would find it well worthy of careful reading. The subject itself deserved more attention, because, from the Abbe point of view, there was nothing left so unsatisfactorily as this attempt to explain the optical theory of the binocular microscope; he should, therefore, have great pleasure in reading the paper, and hoped it might be the means of giving a new value to this form of instrument, for if only the prisms could be made perfect, there was no reason why it should not be possible to use it with much higher powers than hitherto.

Mr. Karop said he could not quite understand the meaning of the terms "inside and outside the pupil," and asked if Mr. Nelson would explain them.

Mr. Nelson said the words were not his; he merely quoted them from the paper, where it said that if you used one half of the pupil you got one effect, but if you used the other half you got the opposite effect.

The President said the idea conveyed was the assumption that the pupil was divisible into two halves; and the effect produced depended upon whether they took the rays which came through the outer halves of the pupils or those which came through the inner halves—whichever they took was said to determine the result.

Mr. Karop said he could not in that sense understand how anything but confusion could result, because the perfection of the visual image must depend upon the image falling on corresponding parts of the retinæ of the two eyes—that was, of course, upon the outer side of one eye and the inner side of the

other eye—and they could not get the image thrown upon the outer halves or the inner halves without getting confusion.

Mr. Crouch said the mention of the subject called to his mind the fact that, some years ago, Mr. Ahrens made a prism for the binocular which could be shifted so as to give in one position a perfectly stereoscopic effect, and in the other a pseudoscopic effect. He explained the construction of the prism by a diagram on the board. The result was so perfect that he rather wondered it had not been more generally adopted.

Mr. Karop thought the principle was patented, and, therefore, opticians were unable to make microscopes on that principle without paying royalties.

Mr. Crouch said he believed there was a patent, but that did not interfere with his making several microscopes on the principle. He got the prisms from Mr. Ahrens, who raised no questions as to his adoption of them.

Mr. Karop said he was sure the Members of the Club would regret to hear of the death of Mr. W. W. Reeves, which occurred on the morning of the 18th inst. Mr. Reeves was one of the original founders of the Club, and continued one of its Members to the end of his life, always taking the greatest interest in its affairs. Those Members who were in the habit of attending the Excursions of the Club would remember that his botanical knowledge was always at their service in the identification of plants found, and in this and other ways he would be greatly missed.

Announcements of Excursions, etc., for the ensuing month were then made, and the meeting terminated with the usual Conversazione, the following objects being exhibited :—

Pennatula phosphorea	Mr. F. W. Andrew.
Euchlanis triqueta	Mr. W. Burton.
Asplanchna priodonta (mounted) ...	Mr. C. Rousselet.

Mr. E. M. Nelson also exhibited a model of a binocular microscope as invented by Cherubin d'Orleans, in 1677, and giving perfect pseudoscopic effect.

TWENTY-SIXTH ANNUAL REPORT.

Your Committee has once more the satisfaction of presenting a favourable Report.

For some years past the number of new Members has been insufficient to make up the usual losses by resignation or death, and attention was drawn to this fact in the Annual Reports. It is with considerable pleasure, therefore, that your Committee is able to record the election of 47 Members in the twelve months up to and including December, 1891, a larger total than in any year since 1880, and they trust every effort will be made to maintain this increase in the future. The resignations and deaths number respectively 18 and seven, leaving our present strength at 380.

The attendances at the meetings have been unusually good, and the papers and communications submitted at them quite up to the average in number and quality, as the subjoined list shows :—

January.—" On Spirochæta from Brentwater and a Tetracoccus from Woking," by Mr. C. J. Pound.

March.—" On Diatom Structure," by Mr. E. M. Nelson.

April.—" On some new Rotifers," by Mr. G. Western. " On some New Organisms found in the Botanical Gardens," by Mr. Grenfell.

May.—" On Mounting Media of High Refractive Index," by Mr. Ingpen.

June.—" On a New Species of Notops," by Mr. Rousselet.

September.—" On the measurement of the Refractive Indices of Various Media used in Mounting," by Mr. Ingpen.

October.—" On a New Cysticercus and its Corresponding Tapeworm," by Mr. Rosseter. " On Two New Rotifers and on the Sense of Vision in Rotifers," by Mr. Rousselet. " On the Males of Two Rotifers hitherto Unnoticed," by Mr. Western.

November.—"On Two New Rotifers," by Mr. Parsons. "On the Diffraction Theory and Frauenhofer's Theorem," by Mr. Nelson.

December.—"On Mounting Selected Diatoms on the Slip," by Mr. Morland.

Other informal communications on new instruments and methods of research will be found in the Proceedings.

As indicated in the last Report the finances have been most carefully controlled, and none but necessary expenses incurred. (For Balance Sheet see p. 121.)

The desirability of holding a Special Exhibition Meeting being freely expressed by many, the matter received the earnest consideration of your Committee, but neither the arrangement and capacity of the rooms available here nor the state of the funds appeared to permit of such a meeting as has always been associated with the name of the Quekett Club. Under these circumstances, and with the full sanction of your Committee, the affair was arranged by private subscription, aud through the kind offices of one of our Members the use of the large hall at Freemasons' Tavern obtained on favourable terms. The meeting was held in April and proved thoroughly successful, so much so indeed that every effort will be made to repeat it during the coming season.

The Excursions have been well attended and the results more than usually prolific. This is particularly the case as regards the Rotiferæ, of which so many entirely new species or hitherto undescribed males were recorded last year that, as the President remarked, it would seem to be the province of the Club to fill the (microscopic) world with these organisms. The investigation of this group, whose position and real affinities are by no means certainly ascertained, is eminently suited to a working society like ours, and the discoveries made are sufficient proof of the interest taken in the subject, and show the value of associated research.

It is with very considerable regret that your Committee has to announce the resignation of our esteemed Treasurer, Mr. F. W. Gay, the more especially as it is mainly due to failing health. He has held this responsible post for over 15 years, and although his duties were very unostentatiously they were always most conscientiously fulfilled, and the Committee and

Members generally are greatly indebted to him for his long-continued and valuable services.

They are, on the other hand, extremely glad to state that the treasurership has been accepted by Mr. J. J. Vezey, whose position and well-known interest in the Club is sufficient guarantee that its financial concerns will continue to be carried on in the most efficient manner.

The Library is now, thanks to Mr. Alpheus Smith, in thorough working order, and has been increased during the past year by the following volumes, acquired by donation, exchange, or purchase:—

"The Microscope and its Revelations." 7th Edition	Presented by the President.
"Journal of the Royal Microscopical Society"	In Exchange.
"Proceedings of the Royal Society" ...	"
"Hardwicke's Science Gossip"	"
"American Naturalist"	"
"American Monthly Microscopical Journal"	"
"Botanical Gazette"	"
"The Microscope"	"
"La Nuova Notarisia"	"
"International Journal of Microscopy" ...	"
"Proceedings of the Geologists' Association"	"
"Quarterly Journal of Microscopical Science"	Purchased.
"Annals and Magazine of Natural History"	"
"Grevillea"	"
"The Anatomy, Physiology, Morphology, and Development of the Blow-Fly" (Prof. Lowne), Parts 1 and 2 ...	"

Transactions and Proceedings of Sundry Societies.

The Cabinet has lost none of its usefulness, especially to new Members, and the usual number of slides has been issued for study. In any collection of the kind, however, and more particularly one like ours, which is continually passed from

hand to hand, an occasional revision and weeding-out of poor or perished specimens is desirable and, indeed, necessary. This involves very considerable labour and judgment, which it is felt must not be thrown entirely on the Curator. Your Committee propose, therefore, to nominate a small Sub-Committee, who will go over the whole Cabinet and take the responsibility of rejecting such preparations as they may find unfit, and, at the same time, prepare a new catalogue.

The following is a list of slides added during the year:—

Mr. R. T. Lewis	... ...	3 slides.
Mr. Pound	... ...	22 ,,
Mr. Morland ...	... ...	1 ,,
Mr. Douglas C. Caush	...	2 ,,
Mr. F. M. Halford ...	...	6 ,,
		34

Your Committee has again to thank the various officers for their several services in maintaining the routine business of the Club. The long time which the majority of them have held office speaks for itself as to the interest taken by them in all appertaining to its success as a society.

Finally, your Committee has every reason to believe that the manifest increase of vitality lately shown in microscopical matters will continue, and, as far as concerns the social aspect, it is of the opinion that Johnson's genial definition of a club—‘ an assembly of good fellows, meeting under certain conditions ” —pre-eminently holds in the case of the Quekett.

QUEKETT MICROSCOPICAL CLUB.

Treasurer's Statement of Accounts for the Year ending 31st December, 1891.

Dr.

		£	s.	d.
To	Balance from 1890	135	0	4
,,	Subscriptions received in 1891	158	0	0
,,	Dividends on Investment	3	19	0
,,	Sale of Journal	1	1	4
,,	Receipts for Plates in Journal	2	0	0
		£300	0	8

Cr.

		£	s.	d.
By	Rent of Rooms and Bookcases (four-quarters)	54	12	0
,,	Expenses of Journal	88	6	7
,,	Postage	5	18	4
,,	Printing and Stationery	5	12	0
,,	Attendance	6	0	0
,,	Petty Expenses	1	4	0
,,	Property Purchased	13	8	11
,,	Balance at Bank	124	18	10
		£300	0	8

Money invested in £2 15s. Per Cent. Consols, £143 13s. 9d.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify the same to be correct.

WM. HAINWORTH, }
JOHN TERRY, } Auditors.

February 11th, 1892.

Note on Fluorite in Apochromatic Objectives.

By E. M. Nelson, F.R.M.S.

As fluorite is becoming scarce, an important question arises as to whether fluorite is or is not present in any given lens. This can readily be determined by means of a polariscope.

The Nicols are crossed, a two-inch objective is placed on the nose-piece, and a low eye-piece employed. The various portions of the objective to be tested are unscrewed, and each combination is separately placed on a glass slip on the stage and examined in the dark polarized field. If the combination contains fluorite, there will be a luminous white silky appearance, but if there is no fluorite, then the field will remain dark.

The following are examples:—The Zeiss, 24 m.m. apochromatic, has three elements, of which the middle contains fluorite. The apochromatic 12 m.m. has four elements, of which the second and back contain fluorite. The apochromatic 6 m.m. has three elements, of which the middle and back contain fluorite. The apochromatic 3 m.m. has five elements, and the last but one contains fluorite.

But with regard to this last example it should be noted that all 3 and 2 m.m. objectives are not alike.

The Rev. Father Thompson's High Refractive Medium.

Mr. E. M. Nelson writes that it will be in the recollection of some of the Members that a few years back he exhibited a beautiful slide of diatoms, mounted in a very dense medium by the Rev. Father Thompson. He is now, through the kindness of Father Thompson, able to communicate the recipe of the composition to the Club. He still has the same slide in his possession, and, so far as it is possible to judge, it has remained unaltered. He therefore begs to commend Father Thompson's high refractive medium to the especial notice of the Club as the best thing that has been done in that direction.

" Take *flower of sulphur*, *bromine*, and *arsenious acid* in the proportions of 8, 10, and 12 respectively by weight. Dissolve the sulphur in the bromine with gentle heat in a thinnish test tube about six inches long. Over a small Bunsen jet add small portions of the arsenious acid, boil and let the condensed vapours of the mixture cool and fall down the sides again. Be very careful that these do not escape. If none of these have escaped, the proportions given will be correct, but, if they do escape, probably a spot more bromine will have to be added to keep the mixture clear.

No mechanical directions can be given beyond these. Success is very much like that of a cook in his preparations, and the eye and understanding must regulate the proceedings. When made the mixture should be about the consistency of toffee and much the same in appearance. It should be handled with a piece of platinum wire. The more arsenic the better, and a grain or two of the metal itself may be coaxed in towards the end so long as the mixture remains clear. If properly made this will last, so far as I know, for ever."

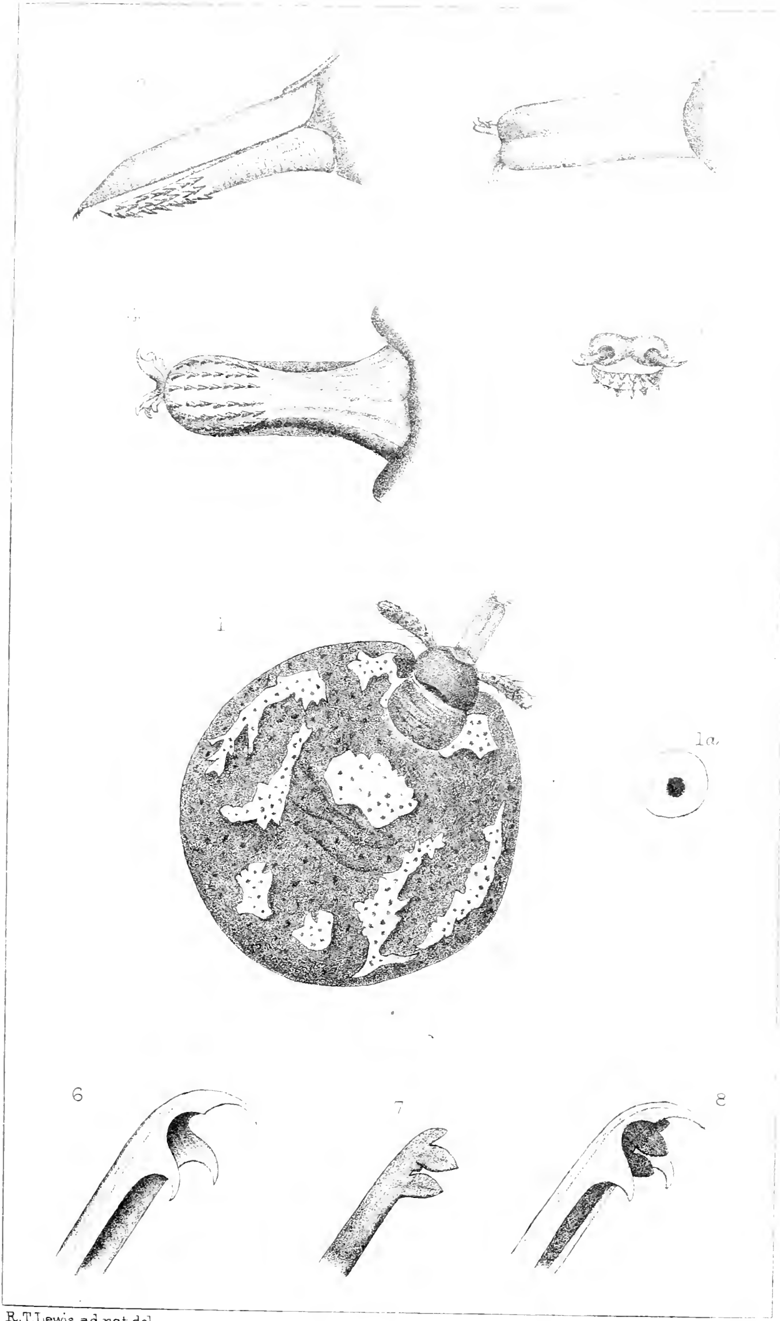
The Senate of the University of Dublin met on Tuesday, June 14th, to consider the proposals of the Board to confer honorary degrees on a number of distinguished men, in connection with the tercentenary celebration. The graces were passed. and amongst the names of those selected for the degree of Doctor of Sciences, we note with pleasure that of the Rev. William Henry Dallinger, London.

NEW BOOK.

"The Essentials of Histology, Descriptive and Practical, for the Use of Students." By E. A. Schäfer, F.R.S., Jodrell Professor of Physiology in University College, London, Editor of the physiological portion of Quain's "Anatomy." Third edition, revised and enlarged. London: Longmans, Green, and Co.

This book, well known as a text-book for medical students, will be found a most useful book for microscopists generally, whatever subject they may have selected for special pursuit, for no work could give them a sounder knowledge of the principles of histology, which would be invaluable in almost any branch of microscopic work, and would also help to an intelligent interest in the work of others and in the progress of microscopical science.

The work is arranged in a series of progressive lessons. The edition now before us contains much additional matter, is illustrated with upwards of 300 carefully executed engravings, many of which are new, thus bringing it well up to date, and also, in an appendix, ample instructions for hardening, cutting, and staining sections, and mounting for examination or preservation.



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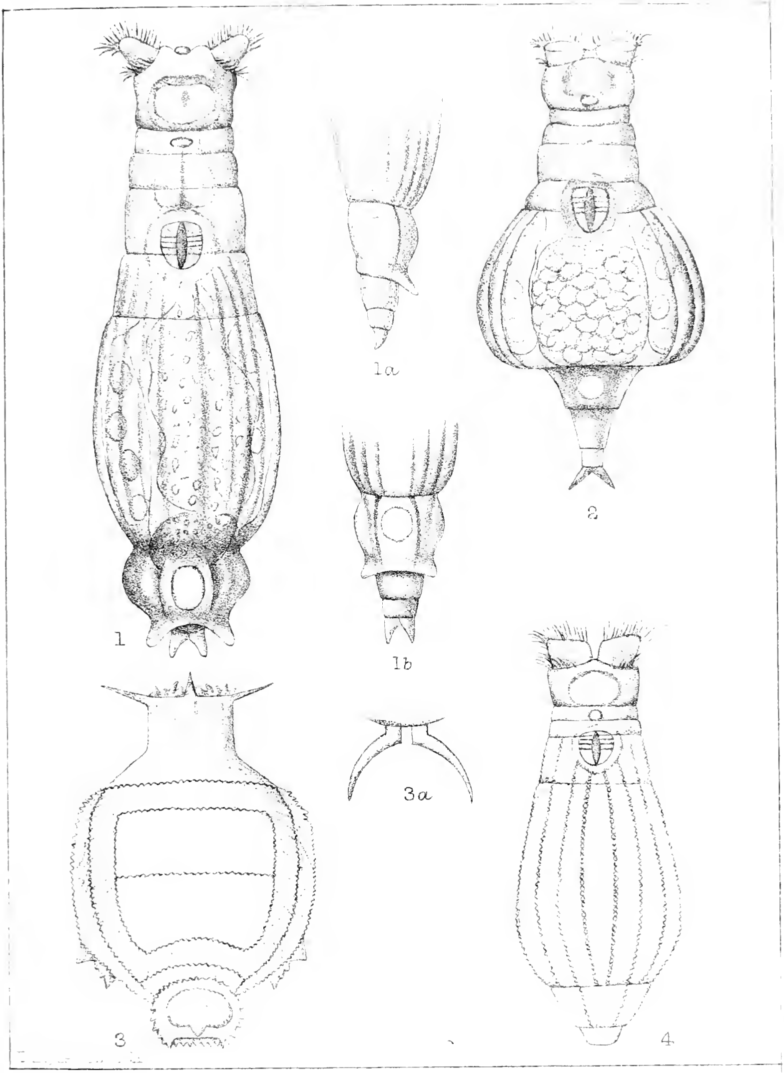

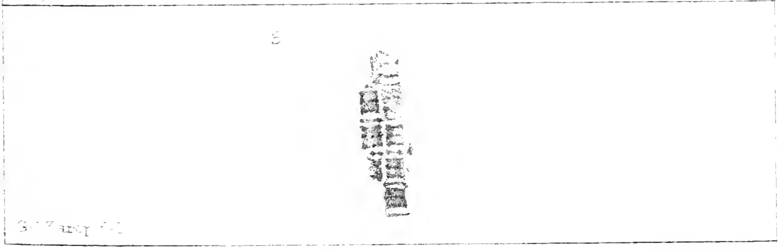

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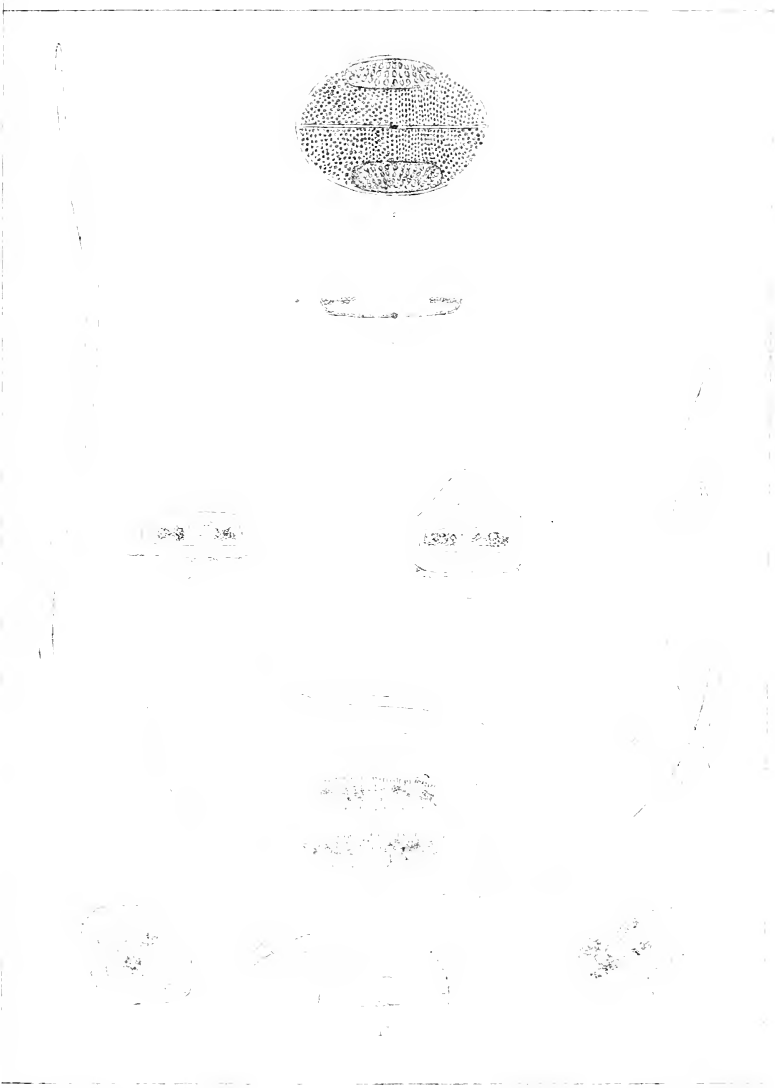

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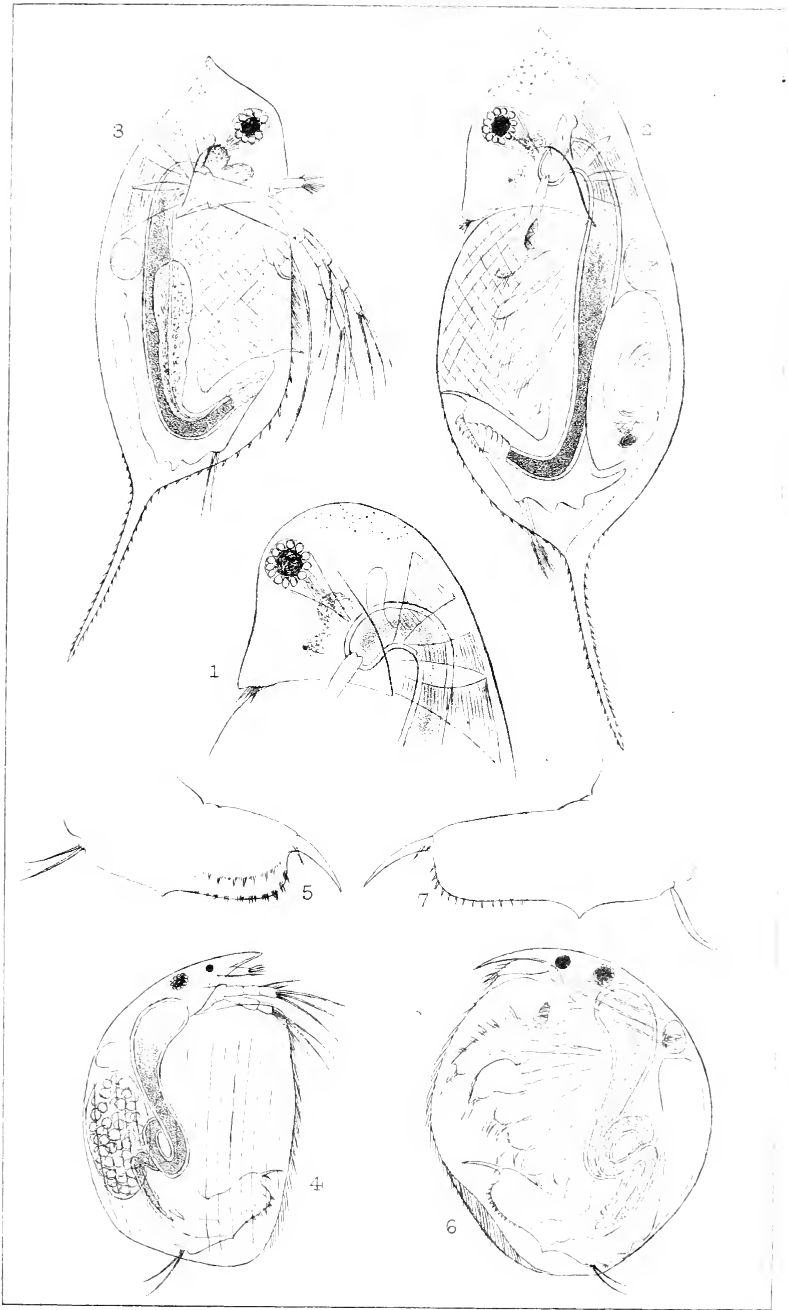


D. J. Scourfield del. West, Newman lith.

The Physiology of Monstera deliciosa.

By Henry W. King.

Plates VI. and VII.

(*Read June 17th*, 1892).

The aroids to which this plant belongs are essentially a distinct class, the largely developed bract enclosing the organs of reproduction forming a feature that separates them from all other forms of vegetation. They are principally natives of the hotter climates, though there are some which inhabit the more temperate climes. The former often attain to considerable size, and seem to scramble among rocks and trees, to which they find support by means of their long, pendulous, aerial roots, that also absorb the moisture rising from the damp earth or subterfluent waters. Those inhabiting the colder and dryer climates are principally herbaceous, and do not attain to large proportions.

A strong acrid principle seems to pervade nearly the whole order in a more or less marked degree. Through it some are rendered exceedingly poisonous, the most remarkable example being the dumb cane of the West Indies and South America. Dr. Lindley states that this species "when chewed has the property of swelling the tongue and destroying the power of speech." Dr. Hooker also relates that a gardener "incautiously bit a piece of dumb cane, when his tongue swelled to such a degree that he could not move it; he became utterly incapable of speaking, and was confined to the house for some days in the most excruciating torments."

But the majestic plant, *Monstera deliciosa*, is free, as its name implies, from the very poisonous principles just referred to, at least so far as the fruit is concerned, which has a great similarity of flavour to a pine-apple. It is a native of Mexico, and luxuriates in a moist atmosphere, where it grows among the tropical vegetation, throwing down long, pendulous, aerial

roots, that cling to rocks and the bark of trees as they ramify from crevice to crevice in their search-like impulse for moisture. The dimension it attains in a natural state is probably very considerable, as every node has a partially independent existence, developing from the upper surface the broad, divided, and perforated leaves, and from the under surface the roots, thus giving to the plant the power of establishing independent individuals with all the specialized functions characteristic of the plant, the same as one developed from a seed; implying that the plant is capable of multiplying its individuality from the germ that originated the plant. So that injury to the stem of the plant, caused by the grip of its own roots or crushing by falling rocks through subsidence of the earth, is an advantage to the species, by causing a multiplied origin of the vitality, and more, a multiplied sphere for the action of crossing by fertilization from flower to flower of the strongest and best plants, the soils and conditions can develop for maintaining or improving the excellence of the species, for this node development and germ development of the plant aims at the one object—the improvement or maintenance of the species. Given a seed which has developed to a plant, the energy of the seed does not stay, but goes on developing to its utmost capacity by the plant dividing into many, each individual plant searching for the best soil and conditions that it may grow and produce a strong flower. Those plants producing the largest, the most attractive flowers are the most likely to receive the visits from insects, thus crossing only the higher and the most perfect forms.

The stem of the specimen from which these observations are made was about three inches in diameter, of a brown colour upon the older parts, and shading to dull olive green where it is less matured, while the fresh-growing portions were of an almost white hue. The surface of the stem is smooth, with the exception of certain protuberances or glands, to be found also on the petiole and the peduncle. These glands are composed of simple cells, and are evidently destined to keep open a communication between the deep-seated parts and the exterior, as the bark is of a close, thick nature. It is interesting to observe the rigidity which these cellular protuberances assume, yet they are merely thin, simple, transparent cells, and acquire

their apparent hardness by the pressure of the fluid within them; they become a series of distended bladders, and while the cells of the tissue surrounding them are capable of depositing colouring and other substances, these cells remain clear and thin-walled, distinct organs, like reservoirs of moisture for the tissues to draw from, to enable them to act in variable conditions of the atmosphere.

Developing from the lower half of the node immediately beneath the axil of the leaf the roots are at first a faint green, almost white as they burst their way through the bark of the stem, swelling as they increase in length, darkening in hue as they mature, except the growing point, which, while above ground, remains greenish white. They continue to descend in search of moisture and food, sometimes trailing serpent-like along the surface of the earth for some yards, and often dividing and sub-dividing until they form masses of twisted and contorted fibres, some of which attain half-an-inch in diameter, and hard as the bark of the stem. Many roots which I have seen clinging tenaciously to cork bark throw out along their surface multitudinous sucker-like expansions, such as are to be seen upon the clinging roots of many climbers, as ivy, only closer, more like velvet pile, while others plunge direct into the earth. Thus, according to conditions, each root is capable of accommodating itself to the state most conducive to its well being. The proportion of root growth to that of the stem and its other appendages is very great in Monstera as compared to plants which require roots mainly for nourishment, and not as in *Monstera deliciosa*, for repetitions of support to enable the plant to ever raise itself into light and air above the growth of tropical vegetation.

In structure the root is principally composed of irregular cylindrical cells, strengthened and supported by long cells of woody fibre, the latter giving to the binding and clinging roots that strength and tenacity and means of rapid conveyance of fluid so necessary to a plant of this description. Coursing through the centre are a number of scalariform ducts, and arranged outside these in a circular growth are a series of pitted ducts. The walls of the cellular tissue of the centre are thinner than those of the cuticle, which become thickened by a brown deposit, and it is this which gives the hardness and

strength to the older roots. The free-growing end of the root, known as the spongiole, develops by the growth of simple spherical cells, which are gradually pressed outwards by others forming, and as they are forced to the exterior they become elongated and form the cylindrical cells, which, in due course, receive the deposit referred to, and become hard and capable of resisting great pressure.

The stem is composed largely of oblong cells of cellular tissue, similar to those found in the root; they are the first series of the cellular structures connected with the cuticle and rough prominences, then groups of spiral vessels imbedded in woody fibre, and next to these scalariform ducts, along the sides of which run disconnected bands of raphides, individually of a long needle shape, while interspersed in the cellular structure which follows are a number of another kind of raphides, which form clusters of square-shaped crystals, in spaces round which the cellular structure often radiates. Similar forms of raphides frequently occur in the cells themselves, and it is possible the apparent spaces were formerly cells in which the raphides were formed, and whose cell walls have become ruptured and absorbed, causing a modified arrangement of the cells surrounding them. Pitted ducts, three to four cells broad, pass down by the side of this formation. Both the stem and root are free from laticiferous tissue.

The upper half of the node may be seen to swell, and gradually the sheath enclosing the leaf bursts through the stem in a similar manner to the bursting of the root from the lower half, developing out from the growing point of the stem about 18 inches, at the same time slowly changing from a cream colour until it acquires a rich green; then the leaf blade which is developing contiguous to, and in the same perpendicular line of growth as the petiole, bursts the sheath surrounding it at the free end, and as the leaf blade continues to mature it uncoils, at the same time the sheath splits, and falling, suspended by its base, turns brown, shrivels, and is finally cast off the plant, leaving exposed the cavity in the under side of the petiole that helped to protect the blade. Meanwhile the leaf, continuing its growth rapidly, unfolds the fresh verdure of the beautifully perforated and divided lamina,

which is raised horizontally and at a right angle to the petiole by means of the petiole at the point of attachment to the leaf, becoming flattened and corrugated, so that the corrugations can fold back upon one another on the upper and stretch on the under side, forming, as it were, a stop hinge, thus enabling the blade of the leaf to rise and, spreading, perform its functions. The cells across the joint approach to a hexagon in transverse section, but as they recede from it they become more cylindrical. Similar protuberances are developed on the convex side of the petiole to those found on the stem, but none are formed upon the concavity of the petiole that sheltered the lamina. A longitudinal section of the petiole shows a series of oblong cylindrical cells, the outer layer coming in contact with the cellular prominences. Many of the oblong cells contain clusters of square-shaped raphides, but these are most numerous in the small hexagonal cells in the node. Passing at intervals between the oblong cells are large fibre cells and bands of needle-shaped raphides. Spiral vessels, consisting of four to five united threads, course along at intervals in the parenchyma structure, surrounded by bands of small woody fibre cells. Laticiferous tissue is sparingly distributed along the stalk. The general structure of the petiole is (including the spiral vessels and raphides) continued through the mid-rib and smaller veins of the lamina. The epidermis of the latter consists of five to six-sided cells, covering loosely-arranged parenchyma; that, with numerous intercellular spaces in it, forms the substance of the leaf. Stomates are distributed over its under-surface, but none exist upon the upper surface away from the veins, upon which a few are to be found. The stomates are formed of two kidney-shaped cells, whose concave sides are opposed to one another, and the cells surrounding them are irregularly six-sided. The limiting cells of the membrane of the apertures in the leaf become thickened similar to the cells forming the limit of the growth of the edge of the leaf. These apertures or perforations are a part of the organization of the plant, gradually moulded from the germ, as any other organ of the plant is, and in a measure essential to the life of the plant. They are an advantage to the plant by allowing the moisture and rain to drip through the apertures to the roots growing beneath them, or the roots

would be kept dry were the leaf a plain expansion, void of sutures and perforations, because the leaves, when growing, have a tendency to overlap one another, similar to the tiles on a roof. So that, were it not for these perforations, the broad, bright verdure, intended to nourish and be a means of support, would, instead, be the means of cutting off a large portion of the fluid supply to the plant.

Growing upon a peduncle axillary to the leaf, the large and beautiful inflorescence may be seen, partially protected by a single bract or spathe, which forms one of the most striking features of this plant. The flowers consist chiefly of a pistil and stamens, arranged in a regular spiral round the spadix. Previous to its expansion, the spathe is coiled round the spadix; it is then a soft, pale green colour, which gradually acquires a hue approaching ivory white when fully matured, and acquiring an additional beauty by the hexagonal markings of the pistils, which were impressed on it by the force of growth in the spadix before uncoiling, and which are retained during its vitality. The duration of the flower in a hothouse is about fourteen days; it is possible that the duration in a state of nature is much less, as fertilization would take place with greater facility. The spathe is composed of cellular tissue, irregularly hexagonal in form, interspersed with spiral vessels. It is remarkable for the amount of laticiferous tissue that ramifies throughout its whole structure; intercellular spaces are numerous, but very little woody fibre is formed in it. The cuticle is well-supplied with stomates, which take the same form as those upon the leaves.

The structure of the peduncle is similar to that of the leaf-stalk or petiole, consisting of the spherical cells forming the rough prominences, oblong cells, bands of woody fibre surrounding spiral vessels, as represented in the section of the leaf-stalk. The rachis is a continuation of the peduncle. Its cellular structure becomes larger, owing probably to a stimulated vitality causing the cells to appropriate more nutriment from the circulating fluid, which is increased by an extra number of spiral vessels distributed through it, and by the thinness of the cell walls, which do not become thickened by deposits as in the more lasting parts of the plant, so enabling the fluids to permeate with greater facility.

The pistils grow in a perfect spiral, close together round the spadix, and—according to the pressure of growth against one another—become more or less hexagonal in form and taper to the base or point of attachment to the spadix. The stigma is the exposed broad, flat expansion, pierced in the centre with an elongated aperture leading to the ovary. The ovary and stigma are the only parts to be distinguished during its inflorescence, and its microscopic structure shows no demarcation between these parts. But when the fruit has arrived at maturity, the cellular structure throughout has become greatly enlarged, and, at a certain stage, the fluid supply to about the upper-fourth of the pistil appears to cease, the result being that that portion becomes of a dry, spongy nature, and having served the two-fold purposes of a conductor to the ovary and a shield to the germ, which it helps to enclose, is thrown off as a shell from the whole spadix. This cast-off portion is probably analogous to the style and stigma, that remaining being the fruit that is destined to nourish and protect the seed developing in the ovary.

The stamens are arranged against the sides formed by the contiguous pistils, and are usually (but this is liable to variation) two to each side of each pistil, making twelve stamens round each segment. The stamens are not seen when the spathe first opens, but by a peculiar growth the spadix and the pistils elongate at the same time, without the pistils becoming larger in diameter, the result being that a vacancy is caused between each side of the pistils, sufficient to enable the stamens to grow beyond the stigma and expand.

The stamens have bilobed anthers supported upon a very broad, flat filament attached to the base of the pistil, in every way well-adapted to their position of growth.

When the stamens first appear above the pistils, the anthers are in a line with one another, but, as development proceeds, the bases of the anthers separate and diverge, and the upper portion bulges as if by a pressure from within, ultimately rupturing with a broad, elongated aperture, out of which the pollen gradually streams. The development of the pollen continues for some time after the first-formed has passed the rupture of the anther, and forces outward until the pollen hangs from each anther of the spadix like miniature catkins, of

a yellow colour and many times larger than the anthers themselves. The pollen in this condition is as smooth, round-flattened bags, pressing against one another and adhering, but if isolated and moisture be applied, they immediately swell to an almost spherical form. The pollen falls to the base of the spadix and is collected by the spathe. At the base of the spadix the pistils and stamens become aborted, the former secreting a greater quantity of honey than the perfect pistil; this accumulates in globules, that trickle down the spadix among the pollen collected there. It would form a ready-arranged collecting spot for those bees which collect pollen for the use of their young, as, in our own country, mason bees do in the making of the so-called bee-bread. And it would seem possible that these pistils became aborted by their continued non-excitement by foreign pollen, through the accumulation of the plant's own pollen, preventing its access to the pistils.

The upper surface of the stigma consists of conical-shaped cells, pointed at the free growing extremity, pale in tint towards the periphery, but as they approach the centre assuming a dark-brown colour. The cells beneath the epidermis are almost colourless and much more loosely arranged, in consequence of which they vary in the outline, being near the centre of an oblong shape, but as they recede from the axis they become oval, and at places where the side pressure of growth is not so great they retain their almost spherical form. Apparently coursing indiscriminately through this cellular tissue are a number of woody fibre cells which attain to very large dimensions in this part of the plant, particularly in the mature condition, when they probably act an important part in conveying fluid, at the same time forming strengthening bands binding the cellular tissue together. Through the intercellular spaces the ramifications of the laticiferous tissue may be seen divided and subdivided in all directions. From the base or point of attachment of the pistil to the rachis at the position *e* (Fig. 8, Plate VII.), spiral vessels may be traced through the cellular structure, being surrounded by bands of woody fibre of a smaller and narrower kind than those independently distributed through the cellular tissue.

It would seem that cells start with a certain formative energy which impels the development of the cell until its utmost

capacity is reached. But when two cells of a like formative energy grow in close relation with one another, the stronger of the two appropriates the formative material to its own structure from the one with the least. The large woody fibre cells are situated among the parenchyma cells, whose function is different, the formation of chlorophyll, secretions, etc., and therefore these woody fibre cells go on developing to the full capacity of their formative energy, having no other kind of cell to influence their non-development. Not so with the smaller kind of woody fibre cells; these grow with cells of a like energy and are stayed in their growth by the appropriations of the spiral vessels, so producing the two kinds of woody fibre cells, the large and small.

Raphides of two kinds exist in the pistil, the long, slender, needle shaped, grouped in bands extending more or less through the centre, and clusters of angular crystals to be found principally in the cells beneath the cuticle of the stigma, though some are to be found in the deeper seated cellular structure. The aperture of the stigma leads through a tube, lined with cylindrical cells, into a double chamber, again divided by a loose cellular division, so forming four compartments in which the four ovules grow. From the base and sides of the ovaries growing inwards are a number of elongated cylindrical cells, that developing almost fill the cavities with a thick stroma of semi-transparent hairlike processes, forming an elastic and adaptive cushion for the ovaries to partially rest and grow upon. It is possible this quick growing cellular structure, imbedded as it is in the fleshy part of the pistil, may increase the temperature of the cavity, at the same time keeping the contents moist, both conditions promoting the growth of the ovule. They may also form a channel of nourishment to the pollen thread, while it lives and develops there as an independent growing organism, for the membranes covering these cells and the pollen thread are extremely thin, admitting of ready permeation of the circulating fluid. The ovules are of a pear shape form, a yellow colour, and coated with a smooth membrane. They are attached to the placenta by an elongated hilum rising from their inner side near the narrow extremity, with the greater diameter upwards, the foramen being at the lower and narrow extremity. Each ovule consists of two coats, the primine and secundine,

the former being traversed by spiral vessels passing through the hilum to the upper extremity of the ovule. The aperture of the foramen passes, narrowing upwards, to the nucleus, the latter consisting of an aggregation of nearly spherical cells of a larger size than the cells composing the primine and secundine.

In the younger ovules I have examined, the nucleus or germ is buried higher in the ovule, but in the more advanced growth it descends to the foramen, through which in the mature forms it protrudes beyond, and in some instances the secundine coat is also exposed beyond the exostome of the primine. This action in the plant is of great importance in securing the fertilization of the germ by the pollen thread, for if the germ were not thus exposed in the ovaries the possibility of their impregnation appears to be very remote.

The pollen is probably brought from the anther of one plant to the stigma of another by the agencies of insects, which are attracted by the honey and the colour of the spathe. They would first alight upon the spadix to collect the honey exuding from each pistil, and in passing downwards would leave behind upon the stigmas the pollen that had adhered to them while collecting at another flower. Many may collect the large quantity of pollen developed to form the so-called bee-bread, and also in so doing would readily bring about the fertilization so necessary for the favourable perpetuation of the species.

The ovule being fertilized, the honey secreted on the stigma hardens to a horny consistency, preventing at the same time the ingress of insects to the ovary, and the evaporation of moisture from it. The fertilized germ, protected as in a sealed chamber, develops to a seed, nourished by the secretion of the fruit surrounding it, until matured, when the secretion ceases, the cellular structure gradually dries and cracks, and the seed hangs ready for wind or bird to carry it to a suitable germinating spot, where it may continue the development originated in the ovule, to the perfected life of the plant. The emanations of that growing life throb out intangible as a wave of light. We feel the presence of that life and the swell of the beautiful that dwells there.

Explanation of Plate VI.

Fig. 1.—A branch of *Monstera deliciosa.* *a.* Aerial roots. *b.* Petiole cut across showing concavity. *c.* Inflorescence with spathe coiled round. *d.* Spathe open showing spadix and spirally arranged pistils. *e.* A leaf uncoiled preparatory to assuming the horizontal position as in *f.* *g.* Corrugated joint of petiole and lamina. *h.* The natural perforations.

,, 2.—Pistil and stamens from spadix. *a.* Aperture of stigma. *b.* Immature stamens arranged round pistil.

,, 3.—Pistil with matured stamen discharging pollen.

,, 4.—Stamen as seen when first appearing above pistil.

,, 5.—Stamen matured showing divergence, bulging and splitting of anthers.

, 6.—Diagrammatic section of pistil. *a.* Upper fourth, which scales off the whole of the pistils of spadix when period for fertilization is passed. The centre represents a typical ovary, style, and stigma, and probable analogy of cast off portion to a style and stigma.

Explanation of Plate VII.

Fig. 1.—Transverse section of root. *a.* Irregular cylindrical cells. *b.* Pitted ducts. *c.* Scalariform ducts.

,, 2.—Growing end of root. *a.* New formed spherical cells. *b.* The same, elongated and strengthened by deposit. *c.* More enlarged cylindrical cell, showing deposit of colouring matter over the cell wall.

,, 3.—Longitudinal section of stem. *a.* Cells forming glandular prominences. *b.* Irregular cylindrical cells with raphide crystals in some. *c.* Small woody fibre cells. *d.* Spiral vessels. *e.* Scalariform vessel. *f.* Cluster of needle-shaped raphides. *g.* Pitted ducts.

,, 4.—Longitudinal section of petiole. *a.* Glandular prominences. *b.* Cylindrical cells. *c.* Small cells of woody fibre. *d.* Spiral vessels. *e.* Large cells of woody fibre. *f.* Needle-shaped raphides. *g.* Square-formed raphides. *h.* Laticiferous tissue.

Fig. 5.—Transverse section of petiole.

,, 6.—Longitudinal section from spathe. *a.* Irregular sided cells of parenchyma. *b.* Intercellular spaces. *c.* Anastomosing laticiferous tissue. *d.* Small woody fibre cells. *e.* Spiral vessels.

,, 7.—Cuticle from spathe.

,, 8.—Section of pistil. *a.* Stigma. *b.* Style. *c.* Ovaries. *d.* Ovules.

,, 9.—Section of ovule. *a.* Primine. *b.* Secundine. *c.* Germ. *d.* Spiral vessels.

,, 10.—Portion of more advanced ovule showing secundine and germ protruding beyond the primine of ovule.

Observations on the Habits of Some Pond Life from the West Indies.

By Henry W. King.

Plates VIII. and IX.

(Read September 16th, 1892.)

Some months ago I suggested to a friend travelling to the West Indies the possibility of bringing pond life from there to this country alive for observation. Knowing the extremes of heat and cold and altered conditions in which lower life in general can live, it seemed quite feasible, and my friend, a Mr. Inglis, kindly offered to bring some with him on his return journey.

I received from him two jars containing dippings from Port Limon and the Island of Colon.

Flag plants grew there, and shrubs and trees flourished by the water's side, providing shade and shelter to alligators bathing in the waters. Naturally favourable spots for microscopic life, it was not surprising some interesting forms should be found living and preying either upon the vegetable or the excrement and remains of animal life abounding there.

The waters were clear, with sedimentary matter at the bottom, that from Port Limon having by far the most, and was of a darker colour than that brought from Colon. All the water plants in both dippings were dead and discoloured, through decay, but the forms of some were partially retained, and the remains of grass stems and roots could be distinguished in the former dipping, while in the latter I have no doubt there were the remains of plants of a species of Chara or Nitella.

A glance with a lens at the waters at once revealed their animated condition. A Cypris would glide with alternate opening and closing valves over the sedimentary refuse, and small worms and Rotifers were swimming freely through the water and among the remains of vegetation from Colon, while

Cyclops swam with its well-known series of jerks, and larvæ of a species of Tipula wriggled their way in the water brought from Port Limon.

Thus both waters appeared to have a fully-inhabited look about them. The many weeks' oscillation on the sea, the changes of temperature, the altered influences of conditions generally, seeming to produce but little harm upon the life in the waters, other than upon the higher life of the water plants, which were unable to adapt themselves to the changes, and perished, though the spores of Algæ have retained their vitality, and are now germinating among the vegetal decay and extending their long green cells.

One of the most numerous forms of life in the water from Colon is a worm of the curious form figured (Pl. IX., Fig. 1). It lives about the stems, rootlets, and refuse in the water, among which it glides, the hair-like tufts from each annulose aiding it in its motion by fixing on the materials on which it is moving, and the muscular bands proceeding in a zigzag line along each side of the animal, by contracting, causes a serpentine movement of the body. Situated at the back of the head are two tufts of hairs which have a very different function to the hairs running along each side of the animal. They do not take part in progression, but, with a strong, nervous impulse, are in a perpetual tremulous vibration when erect, like the antennæ of many insects, notably the Ichneumons. They are longer than the other hairs on the body, and are capable of being folded down, either over the back or forward over the head, according to the direction in which the creature is moving.

The head is tapering, and ends in a long trunk of a very flexible and sensitive nature, capable of being curved or coiled in any direction. The animal uses it mainly for thrusting round stems to aid in drawing itself along, or when the creature is in a vegetable tube, to assist it in making a way, clearing obstructions, and generally feeling its course, and is useful also to assist it up a tube by casting the trunk over the aperture, and assisting in drawing itself out.

It is curious to observe these creatures making their way along a vegetable tube, feeding now, and then gliding a little way, resting a time, then gliding to fresh provender a little further off, in a most happy and contented mood, and living in

this manner sometimes a couple of days in one tube. Sometimes they partially protrude from the tube, thrusting the proboscis in all directions, as if to find the whereabouts of other stems, and then, as if fearful of danger, darting back in the tube as a Mellicerta will do, as though quite conscious of the protective nature of the acquired tube. In doing so, the head is often drawn in so as to throw a fold of the integument partially over it. When feeding upon the vegetable or animal matter softened by maceration in the water, the trunk is mostly curved back over its head, that the mouth, situated upon the under side of the head, near the base of the trunk of the animal, may the better reach the food (Fig. 2, Pl. IX.).

The aperture of the mouth is opened like lips, and the œsophageal bulb (Fig. 2, *a*, Pl. IX.) is thrust forward beyond the lip-like opening, and by a series of quick thrusting out and retractile motions of the œsophagus, the food is torn from what it is adhering to, and quickly passes into the stomach by the relaxation of sphincter muscles at the larger end. After remaining there but a very short time, the food is released by other sphincter muscles at the base of the stomach, and it passes into the intestine, through which it is quickly carried by the peristaltic action of the muscles composing its walls. When the animal is actively engaged in feeding, the remains of the food are expelled in about seven minutes from the time it enters the gullet, to be preyed upon by small Rotifers, Diatoms, and Monads.

These worms, wallowing in numbers among decaying and decayed matter, and nearly always feeding, must have a powerful influence in keeping water pure in a tropical climate, by quickly devouring the refuse falling in the water from animals, insects, and vegetation, seeming, by the quick and almost perpetual action of their digestive system, to change and so prepare the refuse in the water that it may become adapted as food for lower life living there.

Associated with these worms, living among them, and sometimes utilizing vegetable tubes adapted by the worms, is a curious active little Rotifer, very numerous in the dipping from Colon.

This Rotifer, which I propose naming *Fercularia tubiformis*, has a broader head than the trunk, tapering slightly to the

back, with two short horn-like processes at each side, capable of slight contraction and extension. It has one ruby-coloured eye, situated upon a styliform process of the head. The outlines of the trunk follow nearly horizontally from the head to about three-fourths of the length of the animal, where the body is suddenly reduced in size, as each successive ring of the integument becomes smaller than the preceding, this annulous formation enabling the animal to curve and bend in any direction, as each larger ring of its structure works over the smaller. The tail bifurcates from the end of the body, is telescopic, and ends in two powerfully-formed, articulated, toothed claws, curved in outline, and very useful to the animal's mode of life. The animal can at will close the two bifurcating branches of the tail, with the claws attached, so that they lay in the same line but with a downward curve, as in Fig. 2, Pl. VIII. Or it may spread them rigid, as in Fig. 1, Pl. VIII., with the clawlets of the claws elevated or depressed, according to the requirements of the animal. This control over the clawlets is a very important one to this Rotifer, enabling it to use each claw of the tail as a simple tool by thrusting it into substances without the clawlets forming an obstruction, which they would do if they were fixed and always erect. Again, they are useful as a compound tool when they are elevated, by forming a notched hook, stronger and better adapted for loosening materials, and also, as in Fig. 5, Pl. VIII., for drawing earthy particles to their tubular dwellings, which they could not so well do if each claw was a plain, smooth hook.

They live almost entirely in either appropriated tubes formed by the hollow stems of aquatic plants, or burrowings of the worms aforesaid, or tubes constructed by themselves from the flocculent sediment at the bottom of the water. When forming a tube, it is interesting to notice how the animal forces its head into the decaying vegetable matter or refuse, and having made a hollow about half the length of the creature, and as if the matter would not yield further by this mode, it turns round, with its tail in the burrow and the head outside. Then, fixing its notched tail, over which it has considerable control, in either side of the burrow, it moves backwards and forwards, loosening the materials as it does so, and gradually forcing its way in, at the same time pressing the sides outwards sufficiently to enable

it to move up and down, sometimes incessantly drawing earthy particles by means of its tail, to fill up vacancies should they occur, or add to its dimensions when required.

The tubes thus formed are sometimes only three or four times, at others eighteen to twenty times its own length, or even longer. They are composed of fine earthy particles adhering without regularity to one another, often with diatoms and flocculent matter entangled among the particles, and probably held together by some viscid secretion of the animal, insoluble in water. Their forms are varied, often quite straight, at other times curved, some are turned at sharp angles, or carried crossways through other tubes not inhabited.

In all cases the tubes are constructed to enable the industrious creature to swim easily up and down them. Of this they are very particular, any obstruction by bulging out or pressing in occurring by other life coming in contact to damage the tube is at once made right by the Rotifer fixing its claw-like tail or foot to both sides of the tube and jerking backwards and forwards, by so doing again forcing the walls of the tube outwards or inwards, as the case may require, to their former position. Should some of the small earthy particles have been moved away, the Rotifer will then thrust itself out of its tubular dwelling backwards, with its head inside (and, I believe, fixed with its small horn-like processes), and then draw the particles back again in position by means of its claws.

It is a remarkable power these minute animals have over this forked tail of feeling for and selecting particles suitable to their purpose when the so-called eye-spot is hid and buried in the tube, and therefore rendered useless in this condition for action outside the tube.

When the tube appears completed and some loose material has been drawn to the openings to close them, the Rotifer may be seen to swim backwards and forwards, coursing regularly along, mostly going the entire length of the tube, though sometimes stopping short as if to feed, then turning, will go back again.

The sense of adaptability in these Rotifers must be largely developed, as they sometimes take possession of vegetable tubes, and adapt them to their requirements by building a wall with small particles of refuse across the tube (see *c*, *c*, Fig. 5, Pl.

VIII.), as if to reduce the size, and so save themselves the labour of constructing an entire tube.

On one occasion I observed another of the same species enter and pass partially down the tube while the owner was at the other end. When they met both became excited, darting backwards and forwards at one another with a rapid motion; but the trespasser soon turned and quickly fled from the tube and swam away, the pursuer stopping at the end of its tube, and, after protruding its head a little way, turned, and drawing some fine particles of earthy matter with its claws to its dwelling, it closed the aperture again, and commenced journeying up and down the tube as before.

I have watched one live in a single tube for several days, coursing incessantly up and down it, never seeming to rest either at night or day. As they only leave their tubes that they may go elsewhere to adapt or construct another, they are very rarely seen swimming free in the water. When they do they are extremely restless, and always eager to seek the refuge of a cluster of earthy particles or rootlets, into which they try to burrow. What the cause may be that induces them to leave one tube, that has cost them so much labour to make, or adapt to their requirements, for another tube, I am unable to say, unless it may be the necessity of obtaining food, as they seem to feed upon something inside their dwelling, so that when this is devoured hunger necessitates them seeking another tube for the twofold purpose of protection and a feeding ground; or it may be that ova are deposited, and when that is the case the parent leaves the tube it was in, for the use and protection of its coming offspring.

On one occasion I tried the experiment of placing one on a glass slide and allowing the water to evaporate, and after throwing itself into various positions, as if trying to find a means of making itself as small as possible, the Rotifer finally rolled itself into a spherical mass, with its extremities coiled round it, in which condition the carapace-like nature of the dorsal part of the animal may be distinctly seen. Having kept it thus dried up, wrinkled, and apparently dead for over an hour, I covered it again with some water, and in about two hours it gradually began to revive, and ultimately assume its normal condition.

By these Rotifers having the capacity of retaining their vitality after being dried up, the species is adapted for a very wide distribution, for should the ponds in which they live become dry, as frequently happens, the wind would waft these dormant spheres of life, like dust, from one locality to another, and when falling on suitable spots, and conditions being favourable, would become reanimated and originate fresh centres of development.

Another allied species was numerous in the water from Port Limon, but differing from the one just considered by having an orange-coloured body; this, however, may be mainly due to the different kind of food and the water in which it lives, as caterpillars and other life are frequently modified in colour by their diet. Whether from a different habit or owing to their large numbers, they appeared to be more associated in a colony, I had as many as five under the microscope at a time, and the tubes seemed to be more anastomosed together and crossing one another in various directions, forming a small matted mass. From the thicker, more opaque nature of their tubes it was not so easy to observe their habits as in the case of the preceding kind. This difference in their dwelling was probably due more to the different materials used giving them an altered aspect than from any variation of instinct action in their individual construction.

Both this variety and the former were very unaffected at sudden sounds and shaking, a different characteristic to that of most free swimming Rotifers, no doubt due to a sense of security felt in their closed dwelling.

A Rotifer (Fig. 6, Pl. VIII.) living in and also utilizing earthy matter for a protective purpose was at home in the water from Colon. This animal usually imbeds itself in the earthy matter in the water aggregated either among weeds or at the bottom. The lower portion of the body imbedded is curved, as it has so small a foot that it would be useless in retaining it in safety in so light and flocculent material were it not for this modified shape of its body forming, as it does, a larger surface for resistance. When disturbed it draws itself in below the surface, and the opening through which it passes in and out closes over it, so that it becomes buried until it feels the threatened danger has gone, when it may be seen to slowly un-

earth itself by pushing forward its very long horn and tapering head (Fig. 9, Pl. VIII.), with two ruby-coloured eyes, and cautiously expanding its cilia to vibrate like revolving wheels.

This Rotifer, unlike the last-described, but like most of the larger wheel-bearing kinds, is very sensitive to vibration and sound. It sometimes assumes a quiescent form when away from earthy protection, among the stems of water plants, and will remain a considerable time in this condition, apparently resting (Fig. 8, Pl. VIII.); at another time it bends its body over, reclining in a grotesque manner (Fig. 7, Pl. VIII.). May not this habit be a protective one, a simulating a worm, a growing alga, or some other form of life different to its own, so that other life preying upon it in its normal condition would not be so liable to recognize it in its assumed form?

While these brief and fragmentary notes of the habits of the few forms of life living and carried in the small vessels of water given to me from the West Indies illustrate the ever-acting law of adaptability of life—and more in the case of the tube-dwelling Rotifers where they develop the simple action of adaptability to a higher function, that of construction, and where they not only adapt, but from materials build repetitions of the tubes that form their habitations—there are other forms in the water of Rotifers, Vorticellæ, and a variety of life interesting alike from their forms and habits, which time has not enabled me to study.

Explanation of Plate VIII.

Fig. 1.—*Fercularia tubiformis*, n.s., extended. *a.* Ruby-coloured eye supported on elevation. *bb.* Expanding and contractile prominences. *c.* Curved claws, with articulated clawlets. *d, e.* Caudal muscles largely developed in this species. *f.* Stomach. *g.* Rectum. *j.* Anus. *h.* Pharynx. *i.* Pharyngeal muscles.

Fig. 2.—*Fercularia tubiformis*, side view partially contracted. *a.* Eye. *b.* Expanding prominences. *c.* Claws. *d.* Clawlets. *e.* Stomach. *f.* Rectum, both containing diatoms, *gg.*

Fig. 3.—Enlarged ventral view of claw. *a.* Showing arrangement of clawlets, *bb.*

Fig. 4.—*Fercularia tubiformis* dried, showing carapace like nature of dorsal integument.

Fig. 5.—A colony of tubular dwellings of *F. tubiformis*, showing constructed tubes and an adapted vegetable tube. *a.* Extremity of Rotifer extended from tube-collecting refuse to close aperture of tube. *b.* Vegetable tube with Rotifer swimming inside, and (*cc*) wall of earthy particles arranged to reduce size of tube. *d.* Accumulation of refuse closing aperture of tube.

Fig. 6.—Rotifer embedded in sedimentary refuse.

Figs. 7 and 8.—Quiescent forms assumed by above.

Fig. 9.—Head of same as when first extending.

Explanation of Plate IX.

Fig. 1.—Magnified dorsal view of worm from Colon, West Indies. *a.* Tapering head. *b.* Flexible proboscis. *c.* Vibrating hairs. *d.* Anus. *e.* Largely-developed stomach. *f.* Showing natural size of worm.

Fig. 2.—Side view of head showing œsophageal bulb (*a*) protruding beyond opening of mouth, and proboscis thrown back as when the animal feeds.

Fig. 3.—Ventral view of head showing aperture of mouth (*a*).

Fig. 4.—Enlarged view of stomach. *a* & *b*. Bands of sphincter muscles.

Fig. 5.—Enlarged dorsal view of part of body of worm, showing (*a*) attachment of hairs used in locomotion; (*b*) muscular bands partially contracted passing along each side of animal; (*c*) alimentary canal; (*d*) semi-opaque granules in protoplasm.

Fig. 6.—Vegetable tube inhabited by worm. *a.* Showing fold of integument that sometimes partially covers the back of the head of the worm.

On the Adinetadæ, with Description of a New Species.

By David Bryce.

Plate XI.

(*Read September 16th*, 1892.)

Among the numerous species of Rotifera which I find in washings of various mosses gathered from different localities and positions of growth, no one form is of such general occurrence as *Adineta vaga.* It is not, however, one of those species which, so far as we yet know, are only to be found in what we may conveniently term moss-habitats, as it occasionally occurs in pond-dippings, yet in my experience invariably in limited numbers. But in moss-washings it is almost always present, frequently abundant, and this fact suggests that this species, like so many others of the Bdelloida, has special structural and constitutional characters, which enable it to flourish better amid the conditions of life obtaining in moss-habitats than in the open waters of pools and ditches.

As a Bdelloid, its most noticeable character is the form of the ciliary organs. In place of the stout head and the prominent pair of pedicelled discs bearing the ciliary wreaths, or wheels, so conspicuous in the Philodinadæ when swimming or feeding, *Adineta vaga* has the ciliary wreath modified to a mere furring of the ventral surface of a much-flattened head, a furring which is exposed when the creature is travelling about, by means of which it creeps, and which is not adapted for swimming, but only for such creeping. If by chance dislodged from any raised surface on which it is travelling, it must fall through the water until arrested by the bottom or some obstacle whereon it can again gain foothold. It must, therefore, seek its food either on the bottom or on any surface which it can reach without swimming. It is possible that this, to some extent, may account for its supposed rarity, as the

usual methods of collection are not adapted to secure many bottom-feeding forms. It is more likely that its inability to swim handicaps it very seriously in the struggle for existence in pools and ditches, and especially in such as have but a scanty supply of weeds, and that in such places it is actually scarce as a natural consequence.

This same inability to swim is not, however, a serious matter to a creature whose existence is passed where a plentiful supply of water is only occasionally present, and would be of still less importance where the supply of moisture is commonly limited to a thin film covering the stems, or drops lodging in the axils of the leaves, as is the case with many mosses. Besides, if unable to swim, this Adineta can move along at a rapid rate, half-gliding, half-creeping, the body, as well as the head, being now flattened and appressed to the surface on which it is creeping. This flattening of the head and body enables it to travel and to feed in a thin film of water too shallow to allow the stouter Callidinæ to pass, far less to gather food.

The modified corona is not able to attract remote food particles, but can only gather in such as are actually within touch, and the animal has further acquired a peculiar method of feeding. Attaching itself by its toes, it extends itself to full length, keeping the face applied to the opposing surface, and gathering in all available particles, then, suddenly pulling itself back, it again extends in a new direction, and, in this way, without shifting its base, it gathers the food from a circular area, moving on at intervals to commence a new series of extensions. In this habit, peculiar to the limited family of which it is the most common representative, I seem to trace the result of feeding in a restricted area, where food is scarce and where every particle must be utilized.

Thus, the characteristic arrangement of the cilia, while probably detrimental to the existence of the species in pools and ditches, is distinctly advantageous to it in certain moss-habitats.

There are, however, many of the Notommatadæ whose cilia are also arranged upon a face more or less prone and flattened, and which commonly feed while crawling about. In these cases the cilia have usually sufficient power both to attract to

the mouth, when feeding, particles not lying directly in the path, and, when swimming, to propel the animal at a fair speed. Such animals should, in moss-habitats, be able to creep about and compete with Adineta for its food supplies, and, perhaps, outstrip it there, as they and other free-swimming forms have done in the open waters, and it is true that in mosses which habitually grow in wet positions, such as Sphagnum, many of such species do occur. Where, however, the moss grows in a position usually dry, and is dependent for moisture upon showers or falling dews, they are rarely met with, and it is obvious that they cannot endure the alternations of moisture and of dryness experienced by such dry-growing mosses.

Here, then, Adineta, in turn, has the advantage, for, with many others of the Bdelloida, it can protect itself from the effects of evaporation. When the species was first described by Mr. Davis in 1873, he stated, as the result of many trials, that it possessed a surprising tenacity of life in this particular direction, and it is on record that in this it excels even *Philodina roseola*, another noted victim of artificial desiccation. It is certain that the experiments by which Mr. Davis tested the vitality and the endurance of this form were far more severe than the conditions to which it would be subjected in moss growing in the most exposed situations.

It may be urged that the same advantages would be enjoyed by *Adineta oculata*, a form remarkably close to *A. vaga* both in structure and in manner of creeping and feeding, yet having two eyes absent in the latter. I have found it but once, and then on weeds from running water from the river Lea, and I have seen it recorded by no other observer than its discoverer, Mr. Milne, who got it from a pool near Aberdeen, or some 500 miles distant.

There is thus some reason to believe that this eyed species is rare, and I think we may infer that its scarcity in pools is (as in the case of *Adineta vaga*, and so far as that scarcity may be real) a result of its inability to swim. I made no experiments with my colony, but the form may be supposed to have a tenacity of life equal to that of *vaga*. Why has it not obtained a like foothold in moss? In his treatise descriptive of *Callidina symbiotica* (p. 49), Dr. Zelinka gives two reasons for his conclusion that that species leads a life of nocturnal activity and

diurnal rest:—the first is, that, wet weather excepted, the mosses in which it lives are at their maximum of dampness during the night as a result of dewfall, and the second, that that species has no eyes. Mr. Percy Thompson has also suggested, *apropos* of some other forms, that a species with eyes, becoming resident in moss, would possibly tend to become a blind form. These three principles, dovetailing into each other as they do, may well account for the absence of *Adineta oculata* from moss-washings. It is sufficiently near to *A. vaga* to suggest that both forms were originally one and the same, that with eyes being possibly the older type, and that the eyes were lost in *A. vaga*, either by its having become a feeder by night, that season being the most favourable in the dry-growing mosses, or because, when living among the wet mosses, it would be in the dark, even while able to be active in hours of daylight.

Returning again to *A. vaga*, I have for some little time thought that there exist two well-marked varieties of the species. I do not say that intermediate forms do not occur, but the majority of individuals belong definitely to the one variety or to the other, and both are frequently present in the same moss. That which I call the var. *major* is usually larger and stouter, with the head broader in proportion, the styles, which protrude just above and to right and left of the anterior edge of the prone face, strong and bold, while the posterior trunk segments are sharply divided from each other. The var. *minor* is altogether slighter, the styles are inconspicuous, while the trunk segments decrease gradually and without break of lateral outline. It occurs much more frequently than the other. I do not know that these points of divergence are so important as to mark the forms as distinct species, but I hope, by breeding them apart, to ascertain whether they are actual races or merely stages of development.

What I term styles are apparently modifications of the membranous flaps, conspicuous in many of the Callidinæ at the tips of the column. They have hitherto been described as hooks, but I think erroneously.

I conjecture that these two forms were known to Mr. Milne, who, writing in 1886, was seemingly unaware that a description of *A. vaga* had been published long before, for, while stating that he had found two other species with coronæ and

manners similar to those of his *oculata*, he refers one, it is true with much misgiving, to the *Callidina bidens* of Gosse, and states of the other simply that it is distinct, all three forms having two teeth on each ramus. He considers that Ehrenberg's figures of Callidina indicate species with a similar formation of the ciliary organs, and to show that Continental observers were not themselves clear upon the point, I find in Dr. Zelinka's treatise (p. 56) a comparison of definitions by other writers of the genus in question. Among them is one by Eyferth, in "Simplest Forms of Life," published in 1878. I translate one sentence only: "Column and ciliary organ soldered to an acorn-shaped (viewed from above), weakly ciliated, outstretched head."

Upon this Dr. Zelinka remarks that, "according to Eyferth, the column is always outstretched and with the ciliary organs soldered to an acorn-shaped head," a representation which, he proceeds, is only to be explained by the author having either never watched a living Callidina for a time, or that he has wrongly understood what he has seen. The criticism is an unfortunate one. Eyferth's words describe *Adineta vaga* very closely, and as, in those days, every Bdelloid, which had no eyes, was called a Callidina, it is not surprising that he should have assigned its peculiarities to the genus. But it is surprising to me that Dr. Zelinka himself should not have seen *A. vaga*, after his long researches on moss-dwelling Callidinæ, but, beyond including Mr. Davis' article in his Bibliography of the Rotifera, he makes no reference to the species, although discussing the relative characters of several other and earlier described forms. I can only infer that *vaga's* geographical distribution does not extend to Bohemia.

I have now to introduce to you a third species, which I propose to name

Adineta clauda (*n. sp.*).

Sp. Ch.: Outline maggot-like, segments coarsely marked; trunk with lateral longitudinal skinfolds. Head as broad as long, only partly protruding from neck segments. Foot short, thick, apparently abruptly truncate, and ending in broad, sucker-like disc. Second foot-joint a mere skinfold, furnished posteriorly with a row of about ten small, fleshy, papilliform lobes of varying size. Eyes absent.

The great divergence of this species from the Adinetæ already known ought, perhaps, to entitle it to be placed in a new genus, but in the anticipation of further variations from the type being found, I prefer to postpone any definition of suitable generic characters. There is little to add to the specific characters detailed. The sucker-like foot seems to link the species to Discopus, the remarkable marine parasitic genus. It appeared to consist of one stout upper joint, ending in a circular disc, which was applied to the glass, a second joint being represented by a mere skinfold, having the lateral and dorsal (*i.e.*, posterior) margins furnished with ten small processes, in place of the usual spurs; while from the centre of the disc were pushed out momentarily, in the act of taking hold, the usual small lower foot-joints. The animal seemed to have no power of rapid movement, but slowly extended and clumsily crawled about, without a trace of the gliding motion so noticeable in the other species, and this halting awkward gait has suggested the specific name assigned to it. The mastax was rather small and appeared to have two teeth on each ramus. The skin on the ventral side of the neck seemed always to partially cover the face, and was prominent and ridge-like, somewhat hard and rough on the edge. In feeding there seemed a distinct scraping of the food surface, the central line of the face being lifted and made concave, and the roughened edges of the neck-skin approaching each other funnel-wise, much more distinctly than I have seen it in *A. vaga*.

Length, about $\frac{1}{105}$th inch.

Habitat, moss.

For this species I am indebted to a fellow-member of this Club, Mr. G. S. Marryatt, who very courteously offered to procure for me some liver-mosses, and who sent me a quantity of various descriptions from Garelochhead, N.B., in the spring of this year. One specimen only was found, and, unfortunately, my opportunities for its examination were small, as I failed to keep it more than a week, and it was very averse to the needful illumination.

DESCRIPTION OF FIGURES. PLATE XI.

1. *Adineta clauda*, dorsal view.

1*a*. Ventral aspect of head.

1*b*. Ventral aspect of foot.

Note on the Determination of "Optical Tube Length."

By A. Ashe.

(*Read October 21st, 1892.*)

This is one of those practical matters the investigation of which many microscopists postpone indefinitely, and generally end by neglecting entirely, under the mistaken impression that its solution is involved in much difficulty, requiring an advanced knowledge of the laws of optics and a large amount of manipulative dexterity in order to arrive at a satisfactory result, and that even if a correct measurement can be made the information so obtained is of no real value to the worker.

The fallacy, however, of this latter view is so obvious that it needs no refutation to anyone who has taken the trouble to estimate the magnifying power of his own instrument.

To those who are content to accept the figures given in an optician's list as to the amplification of their various lenses the following quotation from Mr. Crisp's well-known article may carry some weight :—

" Microscopists have always recognized that the length of the tube of a microscope is a factor in determining the amplification of the image, that the amplification is generally greater with a 10-inch tube than with one of six inches, and that we obtain an increase of power by pulling out the draw-tube. Here, however, all exact notions as to the functions of the tube length have practically stopped, so much so that there has not been any agreement even as to how the length of the tube is to be measured, whether from the front or back lens of the objective to the field-lens, the diaphragm, or the eye-lens of the eye-piece."

Since these lines were written, now some eight years ago, it has come to be very generally admitted that the optical tube length must be measured from the posterior principal focal plane of the objective to the anterior principal focal plane of the ocular.

But the question obviously arises, where are these focal planes situated, how are their positions to be located, and the distance between them estimated?

The desire for information on these points will certainly not be rewarded by any light the average microscopical text-book may throw on the subject, for, whilst laying stress upon the relationship existing between tube length and amplification, they generally leave the reader very much to his own resources as to the methods employed in solving the former part of the problem.

A recent article* in the "Journal of the Royal Microscopical Society" on this subject is very interesting, but, unfortunately, the method suggested, whilst perfectly accurate and thoroughly scientific, incontrovertible in its theory and capable of giving most excellent results in the hands of an expert, is yet, from its very nature, far too complicated in the details of its manipulation and abstruse in its mathematical principles to meet the requirements of the average worker, whose possession of apparatus is seldom of such an extent as to warrant his undertaking an optical research of no small magnitude, and who frequently hesitates to trust his conclusions to figures obtained by the exercise of a long-forgotten skill in the solution of algebraic equations.

Under these circumstances I beg to call your attention to a simple method of estimating the tube length which will not involve the use of difficult formulæ or any apparatus beyond an ordinary stage micrometer.

It is based upon the increase in power obtained by extending the draw-tube through some measured distance, and is carried out thus:—

A careful estimate is made of the power of the microscope with the draw-tube pushed home as far as it will go, then having determined this the eye-piece is withdrawn three or four inches, the exact amount being noted and the increased power of the instrument remeasured.

We are now in possession of all the data necessary to calculate—not the actual optical tube length, but its arithmetical equivalent—a distinction to be observed, though the difference is immaterial to the purpose in view.

* "R. M. S. Journal" (1892), pp. 545, 546.

As it is a rule in optics that the relative sizes of images formed by a lens at different points in its axis are in strict proportion to the distance of those points from the focus of the lens, we may arrange the following formula:—

$$\frac{AB}{C} = D$$

Where A = Amplification of the instrument with the tube closed.
,, B = Distance the ocular has been withdrawn.
,, C = Increase in power produced by the effect of B.

D is, therefore, the equivalent of the distance separating the focus of the objective from the anterior focal plane of the ocular.

To illustrate this simply, suppose an instrument magnifies 100 times, and that on withdrawing the eye-piece three inches the power is found to be increased to 130 times, the equivalent of the tube length will be by the above rule, 10 inches.

That it can be nothing else can be shown by the old Euclidean process of assuming it to be something else and ascertaining how far this hypothesis agrees with observation, which, of course, will end in a *reductio ad absurdum.*

The chief drawback of this proposed method is that it does not enable the worker to place his finger on any point on the tube and say with certainty, "Here lies the posterior focus of the objective and there the anterior focus of the ocular," but it faithfully gives us a figure which is the equivalent of the distance separating these two points, and this, after all, is the only concern of practical import.

In conclusion, I may point out that there is frequently an extraordinary discrepancy between the true optical and the actual mechanical tube lengths; thus in the case of an instrument in my possession a certain combination of lenses gave an optical tube length of $4\frac{1}{2}$ inches, whilst the substitution of another objective in a much shorter mount increased the tube length from $4\frac{1}{2}$ to $7\frac{1}{4}$ inches, which, if not allowed for, would introduce errors amounting to 60 per cent. in the calculated powers.

Perhaps this may be considered an extreme case, but it serves to emphasize the importance to the microscopist of knowing something more about the optical length of his instrument tube than can be ascertained by comparing its outside dimensions with a foot-rule.

Notes on Rotifers, with Description of Four New Species, and of the Male of Stephanoceros Eichornii.

By Geo. Western, F.R.M.S.

Plate IX.

(*Read October 21st, 1892.*)

Pleurotrocha grandis=Diglena ferox.

In April last year I described a Rotifer which I find in the river Wandle, and which is unmentioned by any of the authorities. I then doubtfully assigned it to the genus Pleurotrocha, chiefly on account of the absence of eyespots. Since the publication of my note on the subject, which, with Mr. Chapman's figure of the Rotifer, will be found in the Journal of this Club for July last, I have had opportunities of examining specimens of *Diglena mustela*, which it very closely resembles, and have come to the conclusion that it would more properly be classed along with that species. Mr. Gosse did not consider that the absence of eyespots excluded that species from the genus Diglena, and therefore I see no reason why mine should not also be admitted. There is already, however, a *Diglena grandis*, and to prevent confusion it is necessary to change the specific name also. In future I propose to call this Rotifer *Diglena ferox.*

Pterodina on Asellus vulgaris.

It may be remembered that when Mr. Parsons described a new species of Pterodina which he had found living commensally on Asellus, and which he named *Pterodina cæca*, I mentioned that in seeking for that Rotifer I had also found the *P. truncata* of Gosse, and, as I then thought, more than one other species. Having since pursued this subject with some care, I have arrived at the conclusion that I have really met with but three species, viz. :—*Pterodina cæca*, Parsons; *P. truncata*, Gosse, and *P. elliptica* of Ehrenberg. The great

variety of form which I then thought amounted to specific difference is, I believe, due to the condition of the reproductive system or to the repletion or otherwise of the digestive organs. The Pterodina described by Dr. Barnett Burn in "Science Gossip," 1889, p. 104, differs in some respects from that which I consider the *P. truncata* of Gosse (*vide* Pl. XXV., Fig 4, Society's Journal, January, 1892), and may possibly be another species, but I have not as yet been able to find it. I have been much assisted in this investigation by Messrs. Bryce and Percy Thompson, both of whom appear to have been acquainted with these forms of Pterodinæ before my attention was directed to them by Mr. Parsons.

Philodina commensalis (*sp. nov. mihi*).

Sp. Char.: Body smooth; corona large with slightly bulging neck; eyes roud-ovate, oblique; teeth two; foot thick, abrupt; spurs large; animal hyaline, colourless; living on *Asellus vulgaris*. Length $\frac{1}{50}$ in.

In the January number of this Society's Journal, on Pl. XXV, Fig 2, Mr. Chapman has given a sketch of a Philodina, which I also found living commensally on some Asellus. As there appears to be no published description of this Rotifer it is necessary to give it a name, and as I have never found it except attached to Asellus, I propose to call it *P. commensalis*. At first sight it much resembles a Rotifer macrurus, but it has nevertheless more of the square compact form of a Philodina. It is hyaline and colourless except for the contents of the alimentary canal. The body is marked with the usual longitudinal flutings, and merges abruptly into the longish thick telescopic foot, which is armed on the penultimate joint with conspicuous spurs, and terminates in the usual toes. The spurs are peculiar in shape, having a distinct heel and being separated by a gap, which is equal to about half the width of the base of the spur. They are broadest at the base, then contract slightly and again widen before tapering to the point. The corona is large, measuring quite the width of the body when the animal is swimming. The neck is thickened and bulging. The frontal column is of the ordinary form. The antenna tapers towards the extremity and is carried rather backwards. Eyes are pale roud-ovate and set at an angle like

those of *P. citrina*. There are two teeth in each ramus of the trophi. The viscera present no peculiarity requiring notice. The reproduction is viviparous. They vary much in size, but average $\frac{1}{50}$in. in length. Habitat: Commensal on *Asellus vulgaris* from Putney, Wandsworth, and Epping Forest.

Stephanoceros Eichornii: The Male.

Although I imagine every member of this Club is acquainted with the handsome rotifer Stephanoceros, and although it has been known since 1761, marvellous to relate, there is no record that anyone has seen the male. Thanks to Mr. Hood, of Dundee, I have recently had an opportunity of doing so, and, though of course all credit for the discovery is due to Mr. Hood, who, it seems, found and hatched the male eggs last year and sent specimens with descriptions and drawings of the male to the Glasgow Microscopical Society, so far as I can learn nothing has been published, and I deem the matter of sufficient interest to bring before you. It was in April that Mr. Hood sent me some Stephanoceros, some of which carried male eggs. He told me that he had been unable to find these male eggs after May last year, but being on the look-out for them found them again in April this year. I have met with but few Stephanoceros this year, and have looked in vain for the male eggs, the season being probably past; with those sent me by Mr. Hood, however, I was very fortunate, for I was able to keep them until the males appeared. These male eggs were more numerous and only about half the size of the ordinary female (parthenogenetic) ova, each female carrying upwards of a dozen of them within the body. Some I measured were about $\frac{1}{500}$in. in diameter. They were laid in batches of three or four, some two or three hours before the young males emerged from them; I could see decided movement of some of the embryos inside the body of the female before the eggs were laid, but in no one instance did I observe a male born alive. On the contrary I almost invariably found the empty shell from which the young had escaped. After birth the young males, measuring about $\frac{1}{180}$in., were within the tube, and from it I distinctly saw two or three of them bore their way out through the side, leaving in one case a hole with ragged edges. This process took them six or eight hours. The appearance of the male is much like that

of other of the floscularian males, and I have roughly sketched it to assist others in future identification. There is a sort of head with two red eyespots. This is surrounded by a ciliary wreath, of which the cilia are very long and active. Below this the body gradually tapers to the foot. There are two antennæ, to which, as to the eyespots, nerves could be traced from a largish square-shaped ganglion in the neck. The sperm sac occupies the lower half of the body cavity. There is also a small contractile vesicle, and the lateral canals, with at least three vibratile tags on each side, are easy to make out.

The development of the female has been described by Mr. Gosse and others, and I have been able to confirm his observations. The eggs I saw developed were, however, invariably laid as eggs before the birth of the young, and I have, as yet, seen no instance of viviparous birth. The eggs were also all laid before the death of the parents, which, however, invariably died before they were all hatched. Viviparous reproduction has been seen by Rosseter, English, Hood, and others.

Notholca Hoodii (*sp. nov. mihi*).

Sp. Char.: Lorica ovato-rhomboid, broadly truncate and with six spines before, narrowly behind; ridges and furrows strongly marked and reaching to posterior margin; two lateral spines on outer surface of dorsal plate of lorica.

This somewhat resembles both *Notholca jugosa* and *Notholca spinifera*. It differs from the former, however, inasmuch as the ridges and furrows on its dorsal lorica reach quite to the posterior margin, and from the latter in the position of the lateral spines, which, instead of protruding from between the two plates, are on the outer edge of the external surface of the dorsal plate, at about the junction of its middle and lower third. I have only seen them lying flat upon the dorsal plate, and was unable to ascertain whether they are moveable like those of *N. spinifera*, as my specimens were few and in a dying condition.

Anuraea biremis of Ehrenberg, another species with spines similarly situated, has only four occipital spines instead of six, which that now described possesses. I am indebted to Mr. Hood, of Dundee, for this Rotifer, who found it at Westport, Ireland, in sea water.

Rattulus bicornis (*sp. nov. mihi*).

Sp. Char.: Body fusiform, with two equal occipital spines; toes two stylate, equal; substyles two; brain clear.

This little fellow I found at Roehampton, but although apparently undescribed, I learn that it is common also in Scotland and Ireland. Its distinguishing feature is the presence of the two equal spines on the occipital edge of the lorica. The whole lorica has also a twisted appearance, and the method of swimming is peculiar. The trophi are of the usual asymmetrical virgate pattern, and its internal economy being as ordinary in members of the genus, needs no comment.

Length about $\frac{1}{120}$in.

Habitat— Pond near Roehampton, Scotland, Ireland; common.

Callidina sordida (*sp. nov. mihi*).

Sp. Char.: Body fusiform, depressed, with alternate enlargements and contractions; opaque; greyish brown; much corrugated and covered with adhering foreign matter; teeth two; foot short and thick; spurs long and flexible at points; two tubercle-like processes on dorsal surface of neck on level of antenna.

This is a large Callidina resembling both *Rotifer tardus* and *Philodina macrostyla* in general appearance, but intermediate in size and paler in colour than either of these Rotifers. It is very sluggish and torpid in habit, being mostly found in a retracted and seemingly dormant condition in the muddy sediment of the washings of the moss amongst which it lives. It is always thickly encrusted with stones and other foreign matter entangled in the viscous secretion which covers it. The integument of the body is very tough and coriaceous in character, and may often be found intact, like an empty shell, after the death of the animal and the disappearance of the softer parts. The longitudinal flutings are very marked. The body is less changeable in form than that of *R. tardus*, and when the animal is moving it retains its somewhat fusiform but depressed shape, with alternate prominent swellings and contractions. The head, neck, and foot are perfectly transparent and colourless, and it is when the head is slowly protruded that the most distinctive feature of the species becomes

apparent, viz., tubercles or horn-like processes at the base of the neck on either side of the dorsal antenna. The corona is powerful, and when extended is about two-thirds the width of the widest part of the body. The anterior column is stout and long. The buccal orifice is wide, and the lower lip large and prominent. The dorsal antenna is sturdy and of the usual form. The trophi are large, with two teeth on each ramus. The foot, which is only protruded when the Rotifer is crawling, is stout and gradual. It is armed with two fair-sized pointed spurs, which are flexible at the ends, but less evidently jointed than those of *R. tardus*. The toes are three, and also want the telescopic joints of those of that Rotifer. Its average length is $\frac{1}{40}$in.

I found it in moss which came from Epping Forest.

The Entomostraca of Wanstead Park.*

By D. J. Scourfield.

(*Read November 18th*, 1892.)

So far as can be ascertained from the literature dealing with the British Entomostraca, comparatively few attempts have been made in this country to obtain good local lists of these very interesting micro-Crustacea, or to systematically watch their appearance in limited areas. The following notes, therefore, of observations upon the Entomostraca of Wanstead Park, extending over the last three years, will probably possess some interest for students of the inhabitants of our lakes, ponds, and ditches.

An undertaking of this sort, if properly and exhaustively carried out, would undoubtedly yield valuable results. So little is certainly known of the distribution of microscopic organisms, of the causes of their apparently capricious appearance and disappearance in particular localities, or of the developmental cycles which many of them pass through, that reliable data bearing upon these subjects would necessarily be of considerable importance. Such data can, for the most part, only be obtained by the careful and long-continued examination of the forms found in small areas, or even in single ponds, in various parts of the country. But it is unreasonable for any one worker to expect to be able to do this completely by himself. In fact, from my experience with the Wanstead Park Entomostraca, I am inclined to think that it is quite impossible for a single individual, even when restricted to a small group of animals, to do full justice to the most limited district. At any rate, I am painfully conscious of my own shortcomings in the attempt. Yet, while believing that much of this work must of

* A short account of this Park, with a good map, will be found in E. N. Buxton's excellent little book on "Epping Forest," published by Stanford.

necessity be done by co-operation, I hope this record will show that, at least, a number of suggestive facts may be accumulated by isolated workers. But it must be remembered by those who may think of commencing or assisting in similar observations upon this or other groups of pond-life, that, unless made with care, such records are worse than useless, and this, of course, implies that, if taken up at all, a considerable amount of labour, almost bordering upon drudgery, must be expended upon them.

In the present case little has been attempted beyond the mere noting of the species found at each visit. The record, therefore, although quite reliable, I believe, as far as it goes, does not throw much light on many points about which information is sadly needed. In spite of this incompleteness, however, there are a few results that appear to stand out pretty clearly, and which, to some extent, justify the work. The most obvious of these, if not the most interesting, is that a rigidly local list has been formed. It is probably by no means exhaustive, although the few additions made during the last two years seem to show that it embraces by far the larger number of the forms actually living in the Park. In common with all other local lists, the present should have some value in connection with the question of distribution, but it is impossible to say anything on this point at present, owing to the very small number of such lists hitherto published. Its relation to our total known fresh-water Entomostracan fauna is, fortunately, more definite, and a comparison with the latter may prove instructive in several ways. Altogether, it appears that about 150 species have been so far recognized as British, and they belong to the various orders as follows:—Phyllopoda, 2; Cladocera, 63; Branchiura, 1; Ostracoda, 51; Copepoda, 33. The number of species here recorded for Wanstead Park is 60, namely: Cladocera, 33; Branchiura, 1; Ostracoda, 12; and Copepoda, 14. The water-fleas of this little district are, consequently, equal in variety to two-fifths of the fresh-water forms known to inhabit the whole of the British Isles, while of the three main orders, the Cladocera show a proportion of a little over a half, the Copepoda somewhat under a half, and the Ostracoda a little under a quarter of the full records in each order respectively. The relative smallness of the Ostracod list may

possibly be due to the fact that sufficient attention was not given to the collection of bottom-sediment, in which many species of this order habitually occur, but it must also be noted that some of the forms included in the complete British list, although occasionally found in fresh-water, are more typically brackish-water animals, and ought scarcely to be put in comparison with those from Wanstead Park.

A second result, arising incidentally from the effort to make as complete a list as possible, is that one new species has been found, and a few others added to the British fauna. The new species belongs to the genus *Candona*, and is considered by Prof. G. S. Brady to be quite distinct from all those previously known. He has provisionally given it the name of *Candona abbreviata*, and has undertaken to describe it. This will probably be done in an appendix to the Monograph of the Ostracoda of the North Atlantic and North-Western Europe, a second portion of which is in preparation by Prof. Brady and the Rev. A. M. Norman. The other species alluded to as having been added to our Entomostracan fauna are *Ceriodaphnia megops*, *C. quadrangula*, *Daphnia galeata*, and *Alona intermedia*. They have already been described before this Society (*ante*, pp. 63-69, Plates IV. and V.), and it need only be added that although subsequently found in other districts, Wanstead Park was the first place from which these forms were taken.

An examination of the first two Tables appended will show that another result has been to obtain some useful evidence as to the periodicity of many species. This periodicity, although well known among the Cladocera, is not, so far as I am aware, usually recognized as occurring among the Ostracoda and Copepoda. The data furnished by this record, therefore, may have some value in suggesting unsuspected powers of reproduction in the latter orders, while even in the case of the Cladocera, some additional light may possibly be thrown upon the limits of the active and resting periods in different species. I do not pretend to say that the periods of activity found to hold good in these cases at Wanstead Park would be exactly matched in other districts; indeed, I have many facts to the contrary, and on purely *à priori* grounds it is scarcely likely that this precise agreement should exist. Nevertheless, the

fact that in this particular area some of the species have appeared and disappeared each year with very considerable regularity is a point that must have at least some significance in relation to the life-histories of these forms and the conditions necessary for their existence. Leaving out of consideration the rarer forms, whose capture must have been more or less accidental, it appears that about sixteen species of Cladocera, four of Ostracoda, and three or four of Copepoda show a limited seasonal distribution. These, with their periods of activity, are shown in table on p. 165.

It is true that by looking only to the earliest and latest records obtained during the three years, as done in the following list, the active period seems to extend in some cases to as much as nine or ten months, but if taken year by year it will generally be found somewhat shorter; and I have also observed that in some of these instances of exceptionally early or late records, only a single specimen was seen or only young forms taken. On the other hand it will be seen that in two cases the active period only lasts for three months. A few further comments on this subject will be given later among the detailed notes of species forming the second part of this paper.

The next result, and the last that seems at all definite, is in close dependence upon the periods of activity and rest alluded to in the preceding paragraph. It is that a well-defined cycle of seasonal distribution of species has been made out in the case of the Cladocera. The evidence of each year on this point is practically the same, as shown by the following statement of the number of species of Cladocera taken at each visit:—

	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1890 ...	—	6	6	11	16	—	18	13	22	19	16	—
1891 ...	1	7	6	10	9	—	—	17	18	17	17	10
1892 ...	6	—	5	11	11	16	17	—	21	18	19	10*
Average†	4	7	6	11	12	16	18	15	20	18	17	10

It will be seen that, with the exception of two or three slight breaks, there is a gradual increase during each year from January to September, then a slight decrease to about

* This and [illegible]her records for December, 1892, have, of course, been inserted since th[illegible]ding of the paper.

† Fractions [illegible]e-half and two-thirds counted as one in this and other averages given s[illegible]uently.

Species.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Sida crystallina . .	...	...	...	...	...	...	...	...	×	×	×	...
Daphnella brachyura . .	...	...	...	...	...	...	×	×	×	...	...	...
Ceriodaphnia megops . .	...	...	...	...	×	×	×	×	×	×	...	...
,, *rotunda** .	...	...	...	...	...	×	×	×	×	×	×	×
,, *reticulata* .	...	...	...	...	×	×	×	×	×	×	×	...
,, *quadrangula* .	..	...	×	×	×	×	×	×	×	×	×	...
Scapholeberis mucronata .	...	...	...	×	×	×	×	×	×	×	...	...
Daphnia galeata . .	...	...	...	...	...	×	×	×	×	×	×	...
,, *cucullata* . .	...	...	...	...	...	×	×	×	×	×	×	...
Bosmina longirostris . .	...	...	...	×	×	×	×	×	×	×	×	×
Eurycercus lamellatus .	×	...	...	×	×	×	×	×	×	×	×	×
Camptocercus macrurus .	...	...	...	...	...	...	×	×	×	×	×	..
Alona costata . . .	...	...	...	...	...	...	×	×	×	×	×	...
Pleuroxus trigonellus . .	...	...	...	×	×	×	×	×	×	×	×	×
Peracantha truncata . .	...	...	×	×	×	×	×	×	×	×	×	×
Chydorus globosus . .	...	...	×	×	×	×	×	×	×	×	×	×
Cypria ophthalmica . .	×	×	×	×	×	×	×	...	...	...	×	×
Notodromas monacha . .	...	...	...	...	...	×	×	×	×	×	...	...
Candona candida . .	×	×	×	×	...	...	...	...	...	...	×	×
,, *fabæformis* . .	×	×	×	×	...	...	...	...	×	×	×	×
Diaptomus castor † . .	×	×	×	×	×	×	...	...	...	...	×	×
Cyclops Scourfieldi . .	...	×	×	×	×	×	×	×	×	×	...	...
,, *vicinus* . . .	×	×	×	×	×	×	...	...	×	×	×	×
,, *bicuspidatus* . .	×	×	×	×	×	×	...	[illegible]	×	×	×	×

* The very exceptional nature of the single Feb[illegible] record of this species prevents it from being taken into consideratio[illegible]here.

† This case rests upon the evidence of one year only.

the middle of November, and from thence a very rapid fall to January again. It thus takes eight months to rise from minimum to maximum, but only half that time to fall from maximum to minimum. The averages for the whole period bring this out still more clearly, and the breaks already referred to are reduced to one in March and one in August (see also upper curve of diagram). These temporary retrogressions deserve a few moments' attention. They may, of course, be due simply to the accidents of collection, but it is also possible that they do represent a real falling off, if not actually in the number of species, at least in the abundance of some, thus causing them to be more easily missed. I am certainly inclined to take the latter view, because in the first place the same breaks have been found to occur in a more marked manner in the records from a single pond (see middle curve of diagram), and secondly because some reasons for the probability of such breaks can be put forward. For instance, the decrease in March may really arise from the fact that during February resting-eggs that happen to be in particularly favourable situations hatch out prematurely, only to be quickly killed by the later frosts or lack of food. There is a good example of this in the case of *Ceriodaphnia rotunda*, one record of which is for the 28th Feb., 1891, though it was not seen again for at least three months. I noted at the time that only a single specimen was found, and also that it was a young one. Again the decrease in August may be due to the great heat of that month, and the accompanying lessening of the volume of water in most of the ponds. Returning, however, to the consideration of the main features of the yearly cycle, it must be noticed as a singular circumstance that the period of maximum development is coincident with, or at most only slightly antecedent to, the principal sexual period of the year, and further that the comparatively high figures reached in June and July seem to be in close connection with a subsidiary season of sexual activity. The true import of these facts must, so far as I can see, remain more or less a matter of speculation at present, but they suggest a possible line of special investigation for the future.

Having now disposed of the chief results obtained from the study of the Wanstead Park Entomostraca, there remain for examination only a few miscellaneous points of a more or less

indefinite character. One of the most noticeable of these is the curious non-appearance of some species of Cladocera in 1891, *e.g.*, *Sida crystallina*, *Alona costata*, and *Alonella nana*. This is the more strange because each of these had been present in 1889 as well as in 1890, and they are all forms that occur pretty plentifully when they do put in an appearance. The first named, too, is one of the largest of the Cladocera, and it seems quite impossible to believe that it, at any rate, could have been overlooked. The most plausible hypothesis to account for their absence seems to be that the unusually severe winter of 1890-91 proved fatal to them in some way or other. In the case of *Sida crystallina* this view receives some apparent support from the fact that the resting-eggs of this species, upon which it entirely relies for continuance from year to year, are dropped to the bottom of the pond, covered only by their own proper membrane, and not enclosed in a protecting "ephippium" as among the Daphnidæ. It seems likely enough, therefore, that they are the more susceptible to extremes of temperature. The particular spots, too, where this species occurs in Wanstead Park are comparatively shallow, and even the bottom mud may have been frozen solid by the prolonged frost. In this case the pressure exerted upon all resting-eggs would be enormous, and they would, no doubt, suffer very greatly if not protected by such extrinsic envelopes as ephippia, which would at least serve to equalize this pressure, and probably to counteract it altogether if containing air-spaces. But how this explanation can be reconciled with the fact of non-appearance one year and reappearance at the same spot in the next is more than I can undertake to say. One thing at least the hard winter of 1890-91 was responsible for, if not for the non-appearance of the species above-mentioned, namely, the almost entire absence of Cladocera on the 31st January, 1891, when only a single individual of *Simocephalus vetulus* could be found.

The periodical occurrence of Cladoceran males and "ephippial" females is another point of considerable interest, and one that must certainly be carefully attended to in future records. Unluckily, in this case, no attempt was made until August, 1891, to separately note these sexually mature individuals, and even since that date the records must be very incomplete in

consequence of the great rarity of these forms in many species. Altogether I have seen sixteen males and eighteen ephippial females. They are given at length, and their seasonal distribution is shown in the third table appended to this paper (see also lower curve of diagram). I do not think any of them are new, with the possible exception of *Alona costata*, but there is no reason why many successes should not reward diligent search in this direction, as the males and ephippial females of a great many species still remain to be discovered. And here I may remark that much of the uncertainty as to the value of some genera in this order seems to me to arise from the fact that the original descriptions were necessarily based entirely upon the parthenogenetic females. In any future revision of the classification of these animals, the males and sexually mature females will certainly have to be taken largely into account.

The results obtained in reference to the seasonal distribution of the Ostracoda and Copepoda are somewhat vague, and not very suggestive, but a short space may be conveniently devoted to them among these more or less indefinite items that we are now considering. It seems that the animals included in these orders, as might, perhaps, have been anticipated, are pretty evenly distributed through the whole year. If they do possess a culminating period it is very probably not the same as that of the Cladocera. It would rather seem as if the maximum development of species was reached in the early part of the year—by the Ostracoda in February and March, and by the Copepoda in April. This is shown by the following statement of the average number of species belonging to the two orders found during the three years:—

	Jan.	Feb.	Mch.	Apl.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Ostracoda ...	6	8	7	6	4	4	5	3	5	5	4	4
Copepoda ...	9	9	9	11	8	10	7	7	8	7	8	9

It is quite clear, however, that a large amount of very careful research is still needed to get trustworthy conclusions upon this subject.

The last of these miscellaneous points that seems to call for notice is in connection with the distribution of species within the Park itself. By keeping separate records for the various ponds, I hoped at one time to get some evidence of well-marked sub-areas, characterized by special forms, and also, perhaps,

evidence of gradual changes in the Entomostracan fauna. But the results have been very unsatisfactory, notwithstanding the fact that a few species have been found to be restricted to single ponds. I think the most that can profitably be given here is a comparison of the total number of species found in each of the principal pieces of water. This is shown as follows:—

	Clad.	Branch.	Ost.	Cop.	Total.
Shoulder of Mutton Pond*	23	—	7	10	40
Heronry Pond	21	—	8	9	38
Perch Pond	28	1	10	10	49
The Lake	18	1	9	10	38

It will be seen, therefore, that the "Perch Pond"—probably the deepest of all—is decidedly the best.

In the following detailed list of the Entomostraca of Wanstead Park, some indication has been given of the places where figures and descriptions of the species can be found among British publications. Advantage has also been taken of the opportunity to insert a few odd notes that could not conveniently be given elsewhere.

Cladocera.

Sida crystallina, O. F. Müller (Baird, Nat. Hist. Brit. Ent.,† p. 107, Tab. xii., Figs. 3-4, and Tab. xiii.). This species is confined, so far as I can discover, to the "Shoulder of Mutton Pond" and the little pond receiving its surplus water.

Daphnella brachyura, Liévin (*Daphnella Wingii*, Baird, Nat. Hist. Brit. Ent., p. 109, Tab. xiv.). This clear water loving species finds its most congenial abode in the "Perch Pond," although it is sometimes met with in other ponds. I first found it in "The Lake" in 1889, but it has not been seen there since the choking-up of that piece of water by *Anacharis* in 1890.

Ceriodaphnia megops, G. O. Sars (? *Daphnia reticulata* in part,

* These ponds may be identified from the map in Buxton's "Epping Forest," already mentioned.

† "The Natural History of the British Entomostraca," by W. Baird, Ray Society, 1850.

Baird, Nat. Hist. Brit. Ent., Tab. vii, Fig. 5; Scourfield, J.Q.M.C., Ser. ii, Vol. v., p. 63, Pl. IV., Figs. 1-3).

Ceriodaphnia rotunda, Straus (*Daphnia rotunda*, Baird, Nat. Hist. Brit. Ent., p. 98, Tab. ix., Fig. 6, and Tab. x., Fig. 4).

Ceriodaphnia reticulata, Jurine (*Daphnia reticulata*, Baird, Nat. Hist. Brit. Ent., p. 97, Tab. xii., Figs. 1-2). Two modifications of this species occur at Wanstead Park. The most evident distinction between them is to be found in the shape of the fornices covering the bases of the large antennæ. In one case these are quite round, but in the other they are produced into strong cusps. Males of both forms have been observed. This species is the least common of the genus.

Ceriodaphnia quadrangula, O. F. Müller (Scourfield, J.Q.M.C., Ser. ii., Vol. v., p. 65, Pl. IV., Figs. 4-7).

Scapholeberis mucronata, O. F. Müller (*Daphnia mucronata*, Baird, Nat. Hist. Brit. Ent., p. 99, Tab. x., Figs. 2-3). The two well-known varieties of this species both occur at Wanstead Park, but the "acute rostrata" or "cornuta" form is much more common, and has a longer period of activity than the "obtuse rostrata" form. From its rarity and late appearance, I suspect that the latter is simply an advanced stage of the former, *i.e.*, a single individual, if living long enough, would pass successively through the "acute" and "obtuse rostrata" forms. The male of this species, recorded 3rd October, 1891, was without the cephalic cornu, although all the females taken at the same time, both with and without ephippia, were of the "acute rostrata" type.

Simocephalus vetulus, O. F. Müller (*Daphnia vetula*, Baird, Nat. Hist. Brit. Ent., p. 95, Tab. x., Fig. 1). This is the commonest and hardiest of the Cladocera of Wanstead Park. It has been taken repeatedly in all the ponds, and figures through the whole of the record without a single break. Directly after the frost of 1890-91, it was the only representative of its order that could be found. On one or two occasions I have seen specimens that would, probably, be better referred to *S. exspinosus*, De Geer, if that can be considered a sufficiently well-marked form to merit a distinct name.

Daphnia pulex, De Geer (Baird, Nat. Hist. Brit. Ent., p. 89, Tab. vi., Figs. 1-3, etc.). It is impossible to say for certain whether the Wanstead Park forms referred to *D. pulex* are

really similar to those of the above reference or not. However this may be, all the individuals so far found have been of one type, a striking peculiarity of which is that the males possess *one* long spur, projecting from the dorsal side of the abdomen, far beyond the edges of the valves. This is not a very common species at Wanstead Park, but may generally be found in a few special spots. It has never been seen in the "Perch Pond."

Daphnia longispina, O. F. Müller (*D. pulex* var. *longispina*, Baird, Nat. Hist. Brit. Ent., Tab. vii., Figs. 3-4). This is the most abundant species of the genus at Wanstead Park. It seems to occur all the year round with only a doubtful break in early spring. The majority of the forms here included agree very well with *D. caudata*, G. O. Sars, now considered by that author to be simply a variety of *D. longispina*. The remainder may possibly belong to a variety of *D. lacustris*, G. O. Sars.

Daphnia hyalina, Leydig (Scourfield, J.Q.M.C., Ser. ii., Vol. v., p. 66, Pl. V., Fig. 1). Only seen on one occasion, viz., 23rd April, 1892. It was from the "Perch Pond," of course.

Daphnia galeata, G. O. Sars (Scourfield, J.Q.M.C., Ser. ii., Vol. v., p. 67, Pl. V., Figs. 2-3.)

Daphnia cucullata, G. O. Sars. No figure of this species is to be found in any British publication that I have seen, but it has been recorded from the Lake District by Mr. Conrad Beck.* It is very closely allied to *D. galeata*, but the eye-spot is absent. They are both found only in the "Perch Pond."

Bosmina longirostris, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 105, Tab. xv., Fig. 3; Norman and Brady, Mon. Brit. Ent.,† p. 6, Pl. XXII., Fig. 4). All the Wanstead Park Bosminas seem to belong to this species. Although exhibiting a considerable amount of variation, none of them ever approach the *B. longispina* figured by Norman and Brady.

Macrothrix laticornis, Jurine (Baird, Nat. Hist. Brit. Ent.,

* See the list of species appended to his paper "On some new Cladocera of the English Lakes," in the "J.R.M.S.," Ser. ii., Vol. iii., 1883, p. 784. Given under the synonym of *Hyalodaphnia berolinensis*.

† "A Monograph of the British Entomostraca belonging to the families Bosminidæ, Macrothricidæ, and Lynceidæ," by the Rev. A. M. Norman and G. S. Brady, "Nat. Hist. Trans. of Northumberland and Durham," Vol. i., 1865-7, p. 354. Also published separately. The references to pages are taken from the separate publication.

p. 103, Pl. XV., Fig. 2; Norman and Brady, Mon. Brit. Ent., p. 9, Pl. XXIII., Figs. 4-5.)

Ilyocryptus sordidus, Liévin (*Acantholeberis sordidus*, Norman, Annals and Mag. Nat. Hist., Ser. 3, Vol. xi., 1863, Pl. XI., Figs. 6-9, and Trans. Tyneside Nat. Field Club, Vol. vi., p. 55, Pl. VI., Figs. 6-9; Norman and Brady, Mon. Brit. Ent., p. 17).

Eurycercus lamellatus, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 124, Tab. xv., Fig. 1; Norman and Brady, Mon. Brit. Ent., p. 50, Pl. XX., Fig. 8).

Acroperus harpæ, Baird (Baird, Nat. Hist. Brit. Ent., p. 129, Tab. xvi., Fig. 5; *Lynceus harpæ*, Norman and Brady, Mon. Brit. Ent., p. 20, Pl. XXI., Fig. 1).

Camptocercus macrurus, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 128, Tab. xvi., Fig. 9; *Lynceus macrurus*, Norman and Brady, Mon. Brit. Ent., p. 22, Pl. XX., Fig. 6, and XXI., Fig. 2). This species has occurred regularly in the "Perch Pond" for the last four years. It has not been taken elsewhere within the Park.

Leydigia acanthocercoides, Fischer (*Lynceus acanthocercoides*, Norman and Brady, Mon. Brit. Ent., p. 34, Pl. XIX., Fig. 5, and XX., Fig. 7). The solitary record of this species was from the "Shoulder of Mutton Pond."

Graptoleberis testudinaria, Fischer (*Lynceus testudinarius*, Norman and Brady, Mon. Brit. Ent., p. 30, Pl. XVIII., Fig. 7, and XXI., Fig. 4).

Alona guttata, G. O. Sars (*Lynceus guttatus*, Norman and Brady, Mon. Brit. Ent., p. 29, Pl. XVIII., Fig. 6, and XXI., Fig. 10).

Alona tenuicaudis, G. O. Sars (*Lynceus tenuicaudis*, Norman and Brady, Mon. Brit. Ent., p. 25, Pl. XIX., Fig. 3, and XX., Fig. 3).

Alona quadrangularis, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 131, Tab. xvi., Fig. 4; *Lynceus quadrangularis*. Norman and Brady, Mon. Brit. Ent., p. 26, Pl. XXI., Fig. 5).

Alona costata, G. O. Sars (*Lynceus costatus*, Norman and Brady, Mon. Brit. Ent., p. 28, Pl. XVIII., Fig. 2, and XXI., Fig. 7).

Alona intermedia, G. O. Sars (Scourfield, J. Q. M. C., Ser. ii., Vol. v., p. 67, Pl. V., Figs. 4 and 5).

Alonella nana, Baird (*Acroperus nanus*, Baird, Nat. Hist. Brit.

Ent., p. 130, Tab. xvi., Fig. 6; *Lynceus nanus*, Norman and Brady, Mon. Brit. Ent., p. 45, Pl. XVIII., Fig. 8, and XXI., Fig. 8).

Alonella rostrata, Koch (*Lynceus rostratus*, Norman and Brady, Mon. Brit. Ent., p. 43, Pl. XIX., Fig. 1, and XXI., Fig. 6).

Pleuroxus trigonellus, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 134, Tab. xvii., Fig. 3; *Lynceus trigonellus*, Norman and Brady, Mon. Brit. Ent., p. 40, Pl. XXI., Fig. 11).

Pleuroxus uncinatus, Baird (Baird, Nat. Hist. Brit. Ent., p. 135, Tab. xvii., Fig. 4; *Lynceus uncinatus*, Norman and Brady, Mon. Brit. Ent., p. 42, Pl. XVIII., Fig. 9, and XXI., Fig. 13). This is a rare species at Wanstead Park, but I found it more plentifully in the autumn of 1889 than in 1891.

Peracantha truncata, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 137, Tab. xvi., Fig. 1; *Lynceus truncatus*, Norman and Brady, Mon. Brit. Ent., p. 36, Pl. XXI., Fig. 9).

Chydorus sphericus, O. F. Müller (Baird, Nat. Hist. Brit. Ent., p. 126, Tab. xvi., Fig. 8; *Lynceus sphericus*, Norman and Brady, Mon. Brit. Ent., p. 48, Pl. XXI., Fig. 12). Next to *Simocephalus vetulus* this is the commonest of the Cladocera of Wanstead Park.

Chydorus globosus, Baird (Baird, Nat. Hist. Brit. Ent., p. 127, Tab. xvi., Fig. 7; *Lynceus globosus*, Norman and Brady, Mon. Brit. Ent., p. 47, Pl. XX., Fig. 5).

I have been assured that *Polyphemus pediculus* used to be taken at Wanstead Park, but I have never succeeded in finding it.

Branchiura.

Argulus foliaceus, Linnæus (Baird, Nat. Hist. Brit. Ent., p. 255, Pl. XXXI.). The records of this species are simply those of a few individuals that chanced to be taken swimming freely.

Ostracoda.*

Cypria serena, Koch. This little species is fairly abundant at Wanstead Park all the year round, but more especially

* The generic and specific names adopted for this order are in accordance with the "Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and of North-Western Europe," by Prof. G. S. Brady and the Rev. A. M. Norman, "Scientific Trans. of the Royal Dublin Society," Ser. ii., Vol. iv., Part ii., 1889, p. 63. No references seem called for in the case of these animals, as the foregoing monograph contains all the information needed.

so during the colder months. It has been found in all the ponds.

Cypria ophthalmica, Jurine.

Cypria exsculpta, Fischer. The admission of this species to the Wanstead Park list rests upon a single specimen taken in "The Lake."

Cypris fuscata, Jurine.

? *Cypris reticulata*, Zaddach.—All the specimens seen have been of the "tessellata" or immature type. Their reference to *C. reticulata*, therefore, although probably correct, is not quite certain.

Erpetocypris reptans, Baird.

Cypridopsis vidua, O. F. Müller. This is one of the commonest of the Wanstead Park ostracods, and has been found in all the ponds.

Notodromas monacha, O. F. Müller.

Candona candida, O. F. Müller.

Candona fabæformis, Fischer. The Wanstead Park specimens are not quite typical, but they are considered by Prof. Brady to belong to this species.

Candona abbreviata, G. S. Brady, M.S. As already mentioned, a description of this new species will be published by Prof. G. S. Brady. But it may be indicated here that it is somewhat similar in side view to *C. pubescens*, Koch, and *C. rostrata*, Brady and Norman, while differing from them in its greater breadth when seen from above. The young of this species are of the "albicans" type, and it should be stated that the records for September, 1890, and October, 1891, rest upon these junior forms.

Ilyocypris gibba, Ramdohr. This is probably more common than would appear from the single record, for its mud-loving habits prevent it from being easily found.

COPEPODA.*

Diaptomus castor, Jurine. This species was not recognized at Wanstead Park until January, 1892. It has only been obtained

* The specific names of the animals belonging to the genera *Diaptomus* and *Cyclops* are similar to those of the "Revision of the British Species of Fresh-water Cyclopidæ and Calanidæ," by Prof. G. S. Brady, "Nat. Hist. Trans. of Northumberland, Durham, and Newcastle-upon-Tyne," Vol. xi., Part i., 1891, p. 68. This "Revision" is also published separately by Williams and Norgate.

from a very small pond--probably the smallest in the Park—by the side of the "Heronry Pond."

Diaptomus gracilis, G. O. Sars. A most abundant species at Wanstead Park. The majority of the males do not possess an appendage at the end of the antepenultimate joint of the right antenna, but I have noticed a few specimens in which this process was well-marked.

Cyclops signatus, Koch.

Cyclops tenuicornis, Claus. Some evidence obtained by watching the later stages of development of this and *C. signatus* leads me to think that they must still be regarded as distinct species, and I have consequently kept them apart in this record. They both occur all the year round, and in all the ponds.

Cyclops Scourfieldi, G. S. Brady. Both the type and the variety described by Prof. Brady have been found at Wanstead Park, usually occurring together, but not constantly. They have never been seen during the colder parts of the year. In further illustration of this preference for a relatively high temperature, it may be interesting to mention that the typical form of this species was the only Cyclops found in the Victoria Regia Tank at the Royal Botanic Gardens, Regent's Park, both in April, 1891, and April, 1892. The water of the tank on the latter occasion was about 80° F.

Cyclops vicinus, Uljanin. I believe the active period of this species is considerably shorter than would be imagined from an examination of the record appended to this paper. The specimens found in September, 1891, and June, 1892, were from the "Shoulder of Mutton Pond"—a pond in which this species is scarcely ever taken. It is possible, therefore, that these two records are in some way exceptional. There can be no doubt that at Wanstead Park the main development of this form is from late November to May. It has never been found in the "Perch Pond."

Cyclops bicuspidatus, Claus. Two or perhaps more varieties are here included under this name, one of which is probably identical with the *C. Thomasi*, Forbes, of Prof. Brady's "Revision," but it is a matter of considerable difficulty to definitely separate these forms, and it is possible that they may be only stages in the development of one species. Like the foregoing species, the present seems to reach its greatest abundance

during the colder parts of the year. I have no record of it from the "Perch Pond."

Cyclops viridis, Jurine. Both the "*gigas*" and "*brevicornis*" varieties of this species are common at Wanstead Park.

Cyclops serrulatus, Fischer. Could any British local list be complete without this ubiquitous and well-marked species?

? *Cyclops macrurus*, G. O. Sars.—The specimens here referred doubtfully to *C. macrurus* were all males, and although possessing very long caudal rami, without serrulated outer margins, may really have belonged to *C. serrulatus*. The typical males of the latter species, by the way, are, so far as I have observed, always destitute of serrulations on the caudal rami.

Cyclops affinis, G. O. Sars.

Cyclops phaleratus, Koch.

Cyclops fimbriatus, Fischer. The three foregoing species are the least common of the genus at Wanstead Park. It is worth notice that neither of them has ever been taken from May to August inclusive.

Canthocamptus minutus, O. F. Müller (Brady, Monograph of British Copepoda, Vol. ii., Ray Society, 1880, p. 48, Pl. XLIV). All the Wanstead Park forms seem to belong to this common and widely distributed species.

TABLE I.—CLADOCERA.

Species.	1890.									1891.											1892.									
	1st Feb.	8th March.	12th April.	10th May.	16th July.	13th Aug.	27th Sept.	11th Oct.	8th Nov.	31st Jan.	28th Feb.	28th March	18th April.	9th May.	22nd Aug.	22nd Sept.	3rd Oct.	17th Oct.	14th Nov.	12th Dec.	30th Jan.	19th March.	23rd April.	21st May.	25th June.	19th July.	9th & 10th Sept.	8th Oct.	12th Nov.	17th Dec.
CLADOCERA.																														
Sida crystallina	...		...	...	..	...	×	×	.	...		.	...	...	...	...	..		..	.	...	...			.		×	×	×	...
Daphnella brachyura	..	..	...	..	×	×	...	...	...	..		...	..		...	×	...	...		...	...	..	...	...	...	×	×	...	..	...
Ceriodaphnia megops	..	...	..	×	×	×	×	.	...	.	...	...	...	.	×	×	...	...	..	.	.	...	.		×	×	×	×	...	..
„ rotunda	...	.	...	...	×	...	×	.		...	×	...	.	...	×	×	...	...	...	..	...	.	...	..	×	×	×	×	×	×
„ reticulata	.	...	...	×	×	...	×	×	..		...	...	.	.	×	×	×	...		.	...	...	..	...	×	×	×	...	×	...
„ quadrangula	.		×	×	×	×	×	×	×	...	..	×	.	×	×	×	×	×	×	.	.	..	×	×	×	×	×	×	×	..
Scapholeberis mucronata	.	..	...	...	...	...	×	×	...	...	.	...	...	.	.	×	×	...	..	.	...	..	.	...	...	...	..	...	...	...
„ „ (var. cornuta)	...		.	×	×	×	×	×	...	...	...	.	.	×	×	×	×	...	...	...	...	...	×	×	×	×	×	...	...	...
Simocephalus vetulus	×	×	×	×	×	×	×	×	×	×	.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Daphnia pulex	.	.	...	..	...	...	...	×	...	...	.		×	...	.	×	×	..	×	×	×	×	×	×	.	×	×	×	×	×
„ longispina	...		×	×	×	×	×	×	×	...	...	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	×
„ hyalina	.	..	...	..	..	...	...	...	...	..	...	...	...	.	..	...	...	...	...	...	.	..	×	...	..	...	...	.	...	...
„ galeata	...	..	...	.	...	.	×	...	.	..	..	...	...	...	×	×	×	×	×	.	.	...	...	...	×	×	×	×	...	...
„ cucullata	..	..	...	...	...	...	..	...	...	...	.		...	...	×	×	...	×	×	.	.	.	...	...	×	...	×	×	...	...
Bosmina longirostris	..	..	...	...	×	..	×	×	×	...	...	...	.	×	×	×	×	×	×	×	...		×	...	×	×	×	×	×	...
Macrothrix laticornis	×	...	...	×	...	...	..	...	...			×	...	...		..	..	.	...	..	.	..	...	..		...	..	...	...	...
Ilyocryptus sordidus	.	...	...	×	...	...	×	...	×		×	..		.	...	...	...	.	×	...	...	×	...	..	...		...	...	...	...
Eurycercus lamellatus	.	...	×	×	×	×	×	×	×		.	.	...		×	×	×	×	.	×	.	..	×	×	×	×	×	×	×	×
Acroperus harpæ	×	.	×	×	×	×	×	×	×	...	×		×	.	×	×	×	×	×	.	×	...	×	×	×	×	×	×	×	×
Camptocercus macrurus	...	...	..	...	×	..	×	×	...	.	...	...	.	...	×	...	×	×	...		.	..	...	...	...	.	×	×	×	...
Leydigia acanthocercoides	...		...	..	.	...	...	...	...		.	...		...	...	...	..	.	×	...	...	...	...	...	..	...	...	...	...	...
Graptoleberis testudinaria	.	...	...	...	...	...	×	×	.	...	..	.	..	×	×	...	...	..	..	...	..	...	...	...	×	×	×	×	...	...
Alona guttata	...	...	...	×	...	..	...	...	...	..	.	...		...	...	...	..	..	.	.		...	...	...	...	...	...	×	...	..
„ tenuicaudis	...		...	..	...	...	...	...	...	.	.	...		...	×	..	.	..	...		...	...	...	...	...	...	...	...	...	...
„ quadrangularis	×	.	.	×	×	×	×	×	×	...	×	.	×	..	..	×	×	.	×	×		×	...	×	..	×	×	×	×	...
„ costata	...		...	...	×	...	×	...	.		...			.	.	...	.	...	...	...	...	...	...	..	...	...	×	×	×	...
„ intermedia	...	.	...	.	...	.	.	...	.	...	..	...	...	...		...	...	×	.	...		...	...	...	..	...	.	...	...	...
Alonella nana	×	.		.	×	...	...	×	.	...	...		...	...	...			.	...		...		...	...		.	...	...	×	...
„ rostrata	...	...	...		.	..	..	...	..	.	...	...	..		...	...	.	.								...	..	..	×	.
Pleuroxus trigonellus	.	...	.			×	×	.	.	..			.	.	.	...	.	×	.	.	...		×	...	...	...	..	...	×	×
„ uncinatus	...	...	..		...	...	.		...		.		...	.	...		.	...	×			...				...	..	..	...	...
Peracantha truncata			.	.	.	×	×	.	.	...		.	.	.	.	×	.	.	.	.		..	...	×	×	×	×	×	×	×
Chydorus sphæricus		.	.	.	.	×	×	.	.	..	.	×	×	.	.	×	.	.	×	.	×	.	×	.	×	×	×		×	×
„ globosus	...	.	.	×	×	.	×	×	.	.		...	...	.	...	×	×	.	.	.	...	...	...	×	×	...		...	×	×
	6	6	11	16	18	13	22	19	16	1	7	6	10	9	17	18	18	16	17	10	6	5	11	11	16	17	21	18	19	10

WANSTEAD PARK ENTOMOSTRACA

Table II.—Branchiura, Ostracoda, and Copepoda.

Species.	1890. 1st Feb.	8th March.	12th April.	10th May.	16th July.	13th Aug.	27th Sept.	11th Oct.	8th Nov.
Branchiura.									
Argulus foliaceus	...	...	.	...	×	×	...	...	.
Ostracoda.									
Cypria serena	×	×	×	×	×	×	×	.	×
" ophthalmica	×	×	×	×	×	...	...	.	
" exsculpta	...	...	...		...		...	...	
Cypris fuscata	×	...	...	...	...		...	×	...
" reticulata ?	.	.	...	...		.	...	.	
Erpetocypris reptans	×	×	×	×	×	.	×	...	
Cypridopsis vidua	×	×	×	×	.	×	×	.	×
Notodromas monacha	.	...	...	.	×	...	×	.	
Candona candida	×	×	×	...	...				...
" fabæformis	×	×	×		.	...	.	...	...
" "abbreviata"	×	×	×	×	×	...	×		...
Ilyocypris gibba	...	...	...	.	...	...	...	.	.
	9	8	7	5	6	2	6	4	2
Copepoda.									
Diaptomus castor	...	...	...	...	...		...		...
" gracilis	×	.	×	×	×	×	×	×	×
Cyclops signatus	×	.	.	×	×	×	.	×	×
" tenuicornis	.	.	×	×	×	.	.	.	.
" Scourfieldi	.	...	×	×	.	×	×	...	
" " (var.)	...		.	.	.	×			...
" vicinus	.	.	×	×	...				...
" bicuspidatus	.	×	.			...	...	...	
" viridis	.	.	×	.	×	.	×	×	.
" serrulatus	.	.	×	×	×	×	.	×	.
" macrurus ?	...		×		...	...	...	...	
" affinis	...	...	×	...	...			.	...
" phaleratus	...	.	.	...	...	...	...	×	...
" fimbriatus	.	×	...	...	...	...			
Canthocamptus minutus	.	.	×	×	.	×	.	×	.
	8	9	11	8	7	7	7	7	6

Species.	1891. 31st Jan.	28th Feb.	28th March.	18th April.	9th May.	22nd Aug.	22nd Sept.	3rd Oct.	17th Oct.	14th Nov.	12th Dec.
Branchiura.											
Argulus foliaceus	...	.	...	...	×	...	...	...	...	...	...
Ostracoda.											
Cypria serena	×	×	×	×	×	×	×	×	×	×	×
" ophthalmica	×	×	×	×	...			...	...	×	×
" exsculpta		...	.	...	...	...					
Cypris fuscata	...	...	...	...	.	.	...			×	...
" reticulata ?		...	...	×	...	.		.	...		
Erpetocypris reptans	.	×		×	×		×	×	.	...	...
Cypridopsis vidua	.		×	...	×	.	×	×	×	×	...
Notodromas monacha			.	.	...	×	×	×	...	...	
Candona candida	.	.	×	×	.	.	...	...	.	×	
" fabæformis	.	×	×	×	...	...	...		...		
" "abbreviata"	.	×	×	×	×	×		×	×	...	
Ilyocypris gibba	.	...	...	.		.		.		.	
	7	6	6	7	4	4	4	5	3	5	2
Copepoda.											
Diaptomus castor	...			...	...	...	...	...		...	
" gracilis	×	.	.	×	×	×	×	.	×	×	×
Cyclops signatus	.	.	.	.	.	.				×	...
" tenuicornis	×	.	×	×	.	.	×	×	.	×	.
" Scourfieldi		.	×	.	.	.	×		...	.	...
" " (var.)		...		...	...	×	×	...			...
" vicinus	×	×	×	×	.		×			...	×
" bicuspidatus	.	×		×					...		×
" viridis	.	×	×	×	×	×	×	×		×	.
" serrulatus	.	×	×	×	.	×	×	.	×	×	×
" macrurus ?		...			...		...	...	...	...	
" affinis		.	.	×	...	...		...		...	...
" phaleratus			...	...	...	...	...	...	×	...	...
" fimbriatus		...	.	...		...	...	.	×	×	
Canthocamptus minutus	.	×	×	×	×	×	×	×	×	×	×
	8	9	8	10	8	7	7	5	7	7	7

Species.	1892. 30th Jan.	19th March.	23rd April.	21st May.	25th June.	19th July.	9th & 10th Sept.	8th Oct.	12th Nov.	17th Dec.
Branchiura.										
Argulus foliaceus	...		...	...	...	.	...	...	...	...
Ostracoda.										
Cypria serena	.	×	×	×	×	×	×	×	×	×
" ophthalmica	×	×	×	...	...		...	.	×	×
" exsculpta		×	...	...	...	...	...	...	...	.
Cypris fuscata	.	×	...	×	.		×	×	×	×
" reticulata ?	...	...	...	.	...	...	...	...	...	
Erpetocypris reptans	...	.	.	×	.	...	.	×	...	...
Cypridopsis vidua		×		×	×	×	.	×	×	×
Notodromas monacha			.	...	×	×	×	×	...	...
Candona candida	.	...	.			...	.	.	×	×
" fabæformis	×	...	...	.		...	.	...	×	...
" "abbreviata"	...	×	×	...	×	...	...	.	.	×
Ilyocypris gibba	...	.	...	...	...	.	...	.	...	...
	5	7	3	4	4	4	5	5	6	6
Copepoda.										
Diaptomus castor	×	×	×	×	.	...	...	...	×	×
" gracilis	×	×	×	×	.	.	.	.	×	×
Cyclops signatus	×	×	×	×	.	.	.	×	×	×
" tenuicornis	×	×	×	×	.	.	×	×	×	×
" Scourfieldi	...	×	×			.	.	.	...	
" " (var.)	...		×		×	×	.	...	...	...
" vicinus	×	×	×	.	.	...	...	.	×	×
" bicuspidatus	×	×	×	×	.	...	×	.	×	×
" viridis	×	×	×	×	.	×	×	.	×	×
" serrulatus	×	×	×	×	×	×	×	×	×	×
" macrurus ?		...		...	...	...	...	...	...	...
" affinis	...	×	×	...	...	...	×		...	...
" phaleratus		...		.	.	...	...	...	...	...
" fimbriatus	.	...	×		...		...	...	×	×
Canthocamptus minutus	×	×	×	×	.	×	.	×	×	×
	9	11	12	8	9	7	9	8	10	10

WANSTEAD PARK ENTOMOSTRACA.

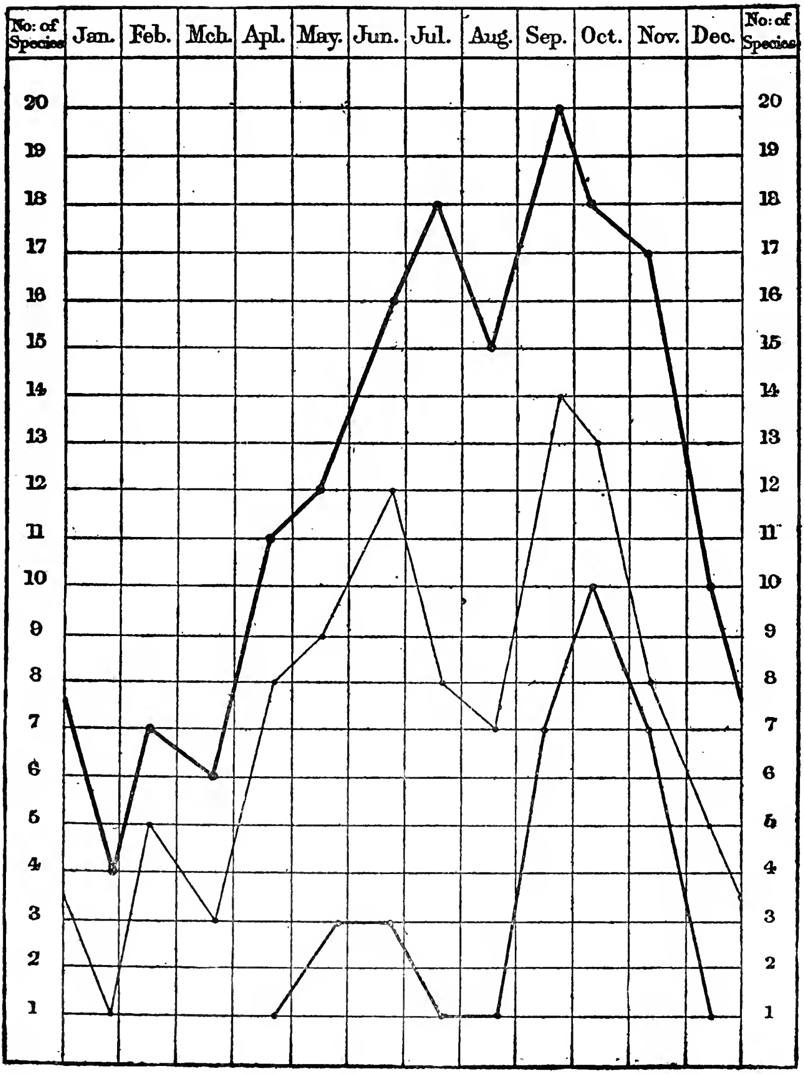
TABLE III.—Males and "ephippial" females of CLADOCERA.

SPECIES.	1891.					1892.							
	22nd Aug.	22nd Sept.	3rd & 17th Oct.	14th Nov.	12th Dec.	23rd April.	21st May.	25th June.	19th July.	9th & 10th Sept.	8th Oct.	12th Nov.	17th Dec.
Sida crystallina	...	...	...	...	...	...	...	...	...	...	♀ ♂	♀ ♂	...
Daphnella brachyura	...	...	...	...	...	...	...	...	...	♂	...	...	...
Ceriodaphnia megops	...	♀ ♂	...	...	...	...	...	...	...	♀ ♂	♀ ♂	...	...
„ rotunda	...	♀	...	...	...	...	...	...	...	♀	♀	...	...
„ reticulata	...	♀	♀ ♂	...	...	...	...	...	...	♀	...	♀ ♂	...
„ quadrangula	...	♂	♀ ♂	♀	...	...	...	♀	...	...	♀ ♂	♀	...
Scapholeberis mucronata	...	♀	♀ ♂	...	...	...	...	...	...	...	...	...	...
Simocephalus vetulus	...	...	♀ ♂	♀	...	...	♀	♀	...	...	♀	♀	...
Daphnia pulex	...	♂	...	♂	♀ ♂	...	...	...	...	...	...	...	...
„ longispina	♀ ♂	♀ ♂	♀ ♂	...	...	...	♀	♀ ♂	♀	♀	♀ ♂	...	...
„ galeata	...	♂	...	...	...	...	...	...	...	...	♀ ♂	...	...
„ cucullata	...	...	♂	...	...	...	...	...	...	...	♂	...	...
Bosmina longirostris	...	...	♀ ♂	♀ ♂	...	...	...	...	...	...	...	...	...
Camptocercus macrurus	...	...	♀ ♂	...	...	...	...	...	...	...	♀ ♂	...	...
Alona costata	...	...	...	...	...	...	...	...	...	...	...	♀ ♂	...
Alonella rostrata	...	...	...	...	...	...	...	...	...	...	...	♀	...
Pleuroxus trigonellus	...	...	...	...	...	...	...	...	...	...	...	♀	...
„ uncinatus	...	...	...	♀	...	...	...	...	...	...	...	...	...
Peracantha truncata	...	...	♀ ♂	♀ ♂	...	...	...	...	...	...	♀	♀ ♂	♀
Chydorus sphericus	...	...	...	...	...	♀ ♂	♀ ♂	...	...	...	...	...	...
	1	8	9	6	1	1	3	3	1	5	10	8	1

WANSTEAD PARK ENTOMOSTRACA.

DIAGRAM SHOWING THE SEASONAL DISTRIBUTION OF THE CLADOCERA.

(1) Total number of species—Upper curve.
(2) Number of species from "Perch Pond" only—Middle curve.
(3) Males and "ephippial" females—Lower curve.
(Averages taken both for numbers of species and for dates.)



On the Cysticercus of Tænia microsoma and a new Cysticercus from Cyclops agilis (Rosseter).

By T. B. Rosseter, F.R.M.S.

Plate X.

(Read November 18th, 1892.)

Cysticercus—(Rosseter) of *Tænia microsoma* (Creplin).

Form of cyst globulous.

Diameter of cyst, 0·237 m.m.

Hooks, 10.

Length of hooks, 0·050 m.m.

Habitat, *Cyclops agilis.*

This hitherto unknown Cysticercus (Fig. 1, Pl. X.) I found parasitic in *Cyclops agilis,* taken from a duck-pond in the parish of Patrixbourne, near Canterbury. Up to the present time I have only captured two specimens, and one of these had evaginated itself in the perivisceral cavity of the Cyclops, the connective tissue of which formed their nidus. The cuticle of the cyst is devoid of striæ, neither is it fenestrated. It is lined with a diaphanous epithelial layer.

The evaginated specimen (Fig. 2) consisted of the rostrum, scolex, and neck, and when dissected from the Cyclops was still adherent to the cyst.

The hooks on the rostrum (Fig. 2*a*) are ten in number, and from the description and drawing given by Krabbe * they correspond with those of *Tænia microsoma* (Creplin). According to the specimens in my possession their individual length is 0·050 m.m., divisible thus: *a-b* 0·034, *a-c* 0·050. Krabbe in his monograph gives them as ranging from 0·035 to 0·061 m.m. —this measurement he explicitly states is after Pfaff and Olrik —but in some specimens of the tapeworm taken by him from

* See "Bidrag til Kundskab om Fuglenes Bændelorme," p. 296, figs. 146-150.

Anas fusca in Nov., 1867, he found the hooks on the rostrum measured 0·043 m.m., which closely corresponds with my specimens. The rostrum was partially invaginated in the connective tissue of the head.

The suckers (Fig. 2*b*) were arranged, as usual, equidistantly round the scolex, and, although they were in an advanced stage of formation, they were deficient in the muscular rigidity which, in the perfect scolex, enables them to adhere to the mucous membrane of the duodenum of their vertebrate host.

The neck (Fig. 2*c*) was short, constricted and bulbous in contour, and it was attached to the cyst by the fibrous tissue of the immature primary proglottis, which latter was partially within the operculum of the cyst.

In neither specimen could I trace the six hooks of the hexacanth stage, as is usual, on the caudal appendage; in both cases this was very short, but I am doubtful if this is the normal condition.

Cysticercus . . . . . ? (Rosseter).
Form of cyst, oval.
Length of cyst, 0·282 m.m.
Width of cyst, 0·255 m.m.
Hooks, 8.
Length of hooks, 0·050 m.m.
Habitat, *Cyclops agilis*.

I took this Cysticercus (Fig. 4), the only one I have captured, from the perivisceral cavity of *Cyclops agilis*, obtained from the same pond as before.

The cyst is oval, striate, and very symmetrical in its contour. The invagination commences very abruptly, and there is a deep crateriform depression at this portion of the cyst (Fig. 4*e*). The cuticular or fluid cavity (Fig. 4*c*) is very deep, more especially the posterior or basal portion, where the caudal appendage *h* enters the cyst. This it does through a ring-collar aperture (Fig. 4*g*), spreading out inside the aperture where it coalesces with, and forms an integral part of, the hypodermis or lining membrane of the cyst (Fig. 4*d*). The parenchymatous tissue was homogeneous in character, so much so that it was impossible to differentiate the usual outlines of
1 rostrum, scolex, and suckers in the formative substance. The

width of the cyst was 0·255 m.m., and the long diameter 0·282 m.m.

The hooks of the future rostrum were eight in number (Fig. 4), including one which was malformed, that is to say, the root was aborted. They formed a fascicle and lay obliquely in the cyst. These hooks are the chief consideration in the investigation of Cysticercoids. as from them alone is determined the species of the mature form or tapeworm. In this instance the extreme length of the hook from the posterior root to the tip is 0·050 m.m., and is divisible thus: *a* to *b* 0·028, *a* to *c* 0·050; *a* to *b* being the length from the posterior to the anterior root, and *a* to *c* the whole length of the hook.

At present we are only acquainted with six species of *Tænia* infesting birds, whose rostra bear eight hooks. These are:—

Tænia gracilis	... ...	0·077-0·080 m.m.
,, *obvelata*	... ...	0·076 m.m.
,, *fasciata*	... ...	0·057 m.m.
,, *fragilis*	... ...	0·056 m.m.
,, *octacantha*	... ...	0·036 m.m.
,, *lanceolata*	... ...	0·031 m.m.

For the sake of comparison of the length of the hook, we may select from this list *T. fasciata* and *T. fragilis* as corresponding most nearly in size to the hooks of the Cysticercus under consideration. The Cysticercus of *T. fasciata* is already known, but that of *T. fragilis* is still undiscovered, and on reference to Fig. 5, hook of *T. fragilis*, and Fig. 6, hook of Cysticercus (?), it will at once be observed that there is no similarity between them.

From the table given below it will be clearly apparent that the length, both of the root and the barb, in either case, for there is great similarity between the hooks of *T. fasciata* and *T. fragilis*, is totally at variance with the one in question.

Tænia fragilis	*a-b* 0·025 m.m. *a-c* 0·056 m.m.
,, *fasciata*	*a-b* 0·025 m.m. *a-c* 0·057 m.m.
Cysticercus . . . (?)	*a-b* 0·028 m.m. *a-c* 0·050 m.m.

It is possible that the final host of this Cysticercus will be found to be either the domestic goose or duck. I am led to

this conclusion from my previous investigations on other Cysticercoids, and because no other species of natatory birds frequent this piece of water.

Description of Plate.

Fig. 1.—Cysticercus of *Tænia microsoma*. *a*, cuticle; *b*, epithelium of cyst; *c*, fluid cavity; *d*, investing membrane of embryonic scolex; *e*, embryonic scolex; *f*, parenchyma; *g*, caudal appendage. × 400.

" 2.—Evaginated embryo from perivisceral cavity of *Cyclops agilis*. *a*, rostrum with hooks; *b*, scolex with suckers; *c*, neck. × 400.

" 3.—Hook from rostrum. × 600.

" 4.—*a*, *b*, *c*, *d* as in Fig. 1; *e*, crateriform depression; *f*, hooks; *g*, ring-collar aperture; *h*, caudal appendage. × 400.

" 5.—Hook of *Tœnia fragilis*, after Krabbe. × 920.

" 6.—Hook of Cysticercus . . . (?) (Rosseter). × 600.

On the Use of Isochromatic Plates in Photomicrography.

By T. F. Smith, F.R.M.S.

(*Read November 18th, 1892*).

Some months ago a letter appeared in the "English Mechanic" from Mr. Lewis Wright lamenting the smallness of the available supply of fluorite for the production of apochromatic objectives for the microscope, and further mentioning the difficulty of getting it, as a formidable obstacle to future optical improvement.

With regard to the truth of the charges made in that letter as to the firm of Zeiss having obtained nearly all the fluorite procurable I have nothing to do, but having been engaged for some time past in experimenting with ordinary achromatic lenses as applied to photography, the conclusion I came to was that given certain conditions the total failure of fluorite might not be so disastrous as it seemed.

My reasons for arriving at this conclusion were, that when using lenses in which the visual and actinic foci were widely divergent when used on ordinary plates, the image came out in sharp focus when isochromatic plates were substituted, thus raising the possessor of an ordinary achromatic objective to the level, photographically, of the owner of the more expensive apochromatic.

Considering the number of microscopists who now register their results by photographing them, I thought this discovery of mine was so simple a one that I hesitated to announce it as something new, but further inquiries convinced me that it was not so known, and I believe the fact is placed in writing here for the first time.

Of course, I am aware that the advantage of using isochromatic plates has been several times mentioned lately, but being always mixed up with the use of a coloured screen or other

light-filter in conjunction with it, the impression conveyed is that the sharpness of the resultant image depended upon such screen or light-filter. To take one single instance. At the last meeting of this Club Mr. Lees Curties exhibited a bottle to hold solutions for giving approximately monochromatic light —such as, for instance, copper chromic solution—and in the discussion which followed Mr. Houghton Gill said, that with this solution and isochromatic plates he had obtained as good, or almost as good, results with a cheap achromatic, as he had been able to do with an apochromatic objective, used without the absorption fluid.

Now, I cannot help feeling that there is some confusion here between cause and effect, and it is to the isochromatic plates, and not to the solution, that is due the fact that the image in the negative came out in the same plane as the one placed on the screen, even when ordinary achromatic lenses were used. I agree with all that Mr. Gill stated with regard to the results obtainable with ordinary lenses, but the evidence of the effect of the solution to me is not conclusive, unless it can be also shown that the results were different when the isochromatic plates were used only without any ray-filter. I do not wish for a moment to deny that any monochromatic light will make a great difference in focus when ordinary photographic plates are used, but it is isochromatic plates we are here dealing with, and I wish to prove that, when these are used, no light-filter whatever is required to produce sharpness of focus; and for this purpose I beg to exhibit prints and negatives taken first on isochromatic, and then on ordinary plates to show the difference of result. The lenses used were all by one maker—Swift and Son—and I believe that the Jena glass is used, but no fluor spar; but I do not wish to imply from this that other makers' objectives will not give the same results.

Prints Nos. 1 and 1*a* show the proboscis of Blow-fly, taken with an inch objective at 300 diameters, first on an isochromatic plate, and then on an Ilford ordinary, and you will see that while the first is sharp in focus, the second is all fluff. I may say in justice to this lens that there is but little divergence of focus when used photographically up to 50 diameters on any sort of plate, but that does not vitiate my argument that whatever difference may exist is corrected by the use of an isochro-

matic plate only. It is not for me to say how this is brought about, but content myself with announcing it as a fact, and leave it to those with more special knowledge to explain why.

Prints Nos. 2 and 2*a* show the Podura scale, taken at about 1,100 diameters, with a $\frac{1}{6}$in., and shows the same difference of result when taken on the two sorts of plates.

Nos. 3 and 3*a* are prints of *Coscinodiscus asteromphalus*, taken at 1,750 diameters with a cheap $\frac{1}{12}$in. oil immersion, and here the difference in focus is simply that between a positive and a negative image of the same diatom when taken first on an isochromatic, and secondly on an ordinary plate, the former being the image produced on the screen of the camera.

All these were taken without any screen whatever, but I have other prints here, taken of histological subjects with the same lenses in which the yellow screen has been used, not, however, to produce a sharper focus, but to render certain colours in the objects more or less actinic. Here a screen certainly is necessary, but, as I have often found when leaving it out accidentally, it makes no difference in the focus whatever.

I can quite bear out Mr. Gill's experience that on suitable subjects almost, if not quite, as good results can be obtained with ordinary objectives as with the more expensive apochromatics, and I may add to this that I have found it a great convenience to be able to include more of the object by not using the eye-piece, but this, with me, only applies to the lower powers, as I find that when using a wide angled $\frac{1}{6}$in. or $\frac{1}{12}$in. this way the curvature of the field more than neutralizes the increased image taken in.

In conclusion, I may say that I bring this subject before you in no controversial spirit, but only to elicit the truth, whatever it may be.

Address on the Mineralization of the Minute Tissues of Animals and Plants.

By Prof. W. C. Williamson, LL.D., F.R.S., Emeritus Professor of Botany in the Owen's College, Manchester.

(*Delivered December* 16*th*, 1892.)

Although, Mr. President, you are such an old friend, I nevertheless believe that this is the first time I have been put under your command, but as I know you will be a very considerate lord and master, I promise most faithfully to submit to your authority. But, now, gentlemen, I am not quite so sure that I am in equally good humour with some other matters connected with this little affair. I was going to say that in an evil moment, I promised your Secretary if an opportunity ever occurred when I could be of service to the Society which bears the name of one of the oldest friends of my life, I should be very happy to place myself at his disposal, and the result is that you have been drawn here this evening.

I know what the general character of your work is, and I am afraid that ever since I ceased to be a Rotiferous and Foraminiferous man, much of the work I have been engaged upon has been very foreign to your pursuits here. However, when I found that I was in for something, the question was, what will interest a group of technical microscopists, and, Mr. President, I was almost at my wits' end to think of a suitable subject. However, I happened of late to have been considering some matters directly connected with microscopy, and I thought I might be able to give my address a form which would not be altogether stupid and uninteresting to you. Anyhow, if I fail, sir, the fault must be mine and not that of my audience. What I aim at speaking about is some of the leading processes connected with the mineralization of plants and animal remains, and the formation by such processes of what we technically call "fossils.'

Now at the first glance, this is a very simple question, involving very few and easily understood elements. Of course, there are certain examples of animal life, and even some cases in all probability of plants too, in which we find nothing but protoplasm, which is a wholly soft tissue; then there are others in which—like shells and crustaceans—there are various forms of a hardened external integument or shell—whilst in a third group you have an internal skeleton clothed externally with soft tissues. Now, as a general rule, when we speak of fossils we refer to the hardened structures—we speak of the shells of the Mollusca, the hardened chitinous skin of Insects, or the internal skeletons of the higher forms of life.

Let us take a very simple case; here (drawing) we have an organic structure imbedded in soft mud, but which mud under various subsequent processes of nature became hardened, excluding the air from the imbedded object. In fact, it became an organism enclosed in a mould, from the interior of which the atmosphere was excluded. At a still later period this shell was exposed to the action of destructive agencies, chiefly in the shape of acids held in solution in the water of the sea. Supposing that this shell was composed of carbonate of lime and buried in the bed of the sea the superincumbent water containing carbonic acid would filter through the mud, and reaching the shell would dissolve out the lime and leave a defined cavity behind it. Sometimes this cavity remains unoccupied. At the Royal Society last night some interesting cases of this kind were brought before us. Some skulls and other bones of some Reptilian vertebrates had been thus imbedded, but of which not a trace of the animal substance remained. But by filling these cavities with some plastic material, I think gutta percha, Mr. Newton, of Jermyn Street, was able to represent to us the reconstruction of such remains of these animals as had originally filled these cavities.

It is important at this stage of our inquiry to note some of the facts essential to our comprehension of what took place. In the simpler case already referred to, an organic, calcareous structure disappears, and is merely replaced by the same calcareous material in an inorganic state. It is known to all familiar with the simplest elements of chemistry that water containing certain proportions of carbonic acid is capable of

dissolving carbonate of lime. You are all familiar with that fact from your knowledge of what takes place in many subterranean caverns; water filtering through cracks and crevices of calcareous strata on its way to the cavern brings along with it, in solution, lime that it has picked up in the manner just referred to. But when such a solution is exposed to the atmosphere the water again throws down the lime so obtained. On reaching the cavern and dropping from the roof it becomes thus exposed. The precipitated lime now coheres to form the stalactitic pendants that hang from the roof, and what remains reaches the floor, where it produces the layers and pillars of stalagmite, as these lower formations are called.

Now this is precisely what takes place in many forms of fossilization. The original shell had a characteristic structure of its own. It was replaced by the same chemical substance, but which was now in a purely mineral form, whether crystalline or amorphous. But we have some cases with a yet simpler form of change, where little or no destruction of the original object has taken place. I daresay some of you have visited the celebrated dropping well at Knaresborough, and have seen the fossil wigs, birds' nests, baskets of eggs, etc., that are regularly produced for sale at that place. This, however, is what may be termed fossilization by investment. All the objects in question retain their normal features, and have practically undergone no change beyond receiving something closely resembling a coat of white-wash. Though this cannot properly be called fossilization, a result not altogether foreign to it occurs in Nature. Thus there are objects which are more or less porous, and when solutions of lime reach such, though they undergo little or even no change in their outward forms, the solution penetrates their minute internal cavities and canals and fills them up. This, again, is little more than fossilization by investment, since it only invests the surfaces of the tissues of the organism, instead of replacing them. But this latter process plays a very extensive part in the preservation of such forms as are of vegetable origin, to some special cases of which I shall shortly call your attention, and some beautiful examples of which will be shown to you at the close of my observations.

Of the examples of lime thus deposited in the interiors of

closed cavities we have two distinct conditions, sometimes in the same cavity. I have at home a magnificent specimen of a Nautilus from the Mountain Limestone of Craven, in which all the closed chambers characteristic of the posterior part of that spiral shell are filled with fine crystalline forms of carbonate of lime or calcareous spar. This condition is very common amongst the fossils found in the limestone rocks.

But, on the other hand, I could show you some fossil Calamites from the coal measures where the first deposits in the interior of a large cavity, from which the pith has disappeared, consist of beautiful layers of the fibrous form of lime, known as Arragonite; but after a while this formation has ceased, and the solution in the centre of the cavity has shot into crystals of calcareous spar.

But cases of a less simple kind are much more numerous. In these the cavity created by the disappearance of the imbedded organism becomes filled with other foreign ingredients: these are chiefly lime, silica, and iron. Often no traces of the original object are preserved. A geologist applying his hammer to stones of this kind would, on breaking up the matrix, find a pseudomorph of the object originally enclosed within it, but which instead of being composed as the original was, say of lime, was now composed of flint or iron.

Another branch of our subject closely allied to that now under consideration is that of the protracted preservation and ultimate transformation of the fossilized objects. It is very difficult to understand how, in many cases, objects primarily prone to decay, resisted that tendency sufficiently long to become replaced by mineral matter. We have already seen that in many instances they were not preserved long, but in others, as in many of our Carboniferous fossil plants, every minute tissue is preserved almost exactly as it was when living. As a rule it is probable that the process of decay is impeded by the complete exclusion, in many such submarine conditions, of all atmospheric influence, whether organic or chemical. Anyhow the process was often arrested sufficiently long to admit of the perfect preservation of the most delicate tissues.

When I was a youth another important observation was made by Professor Turner, the then distinguished chemist. He found that the replacement of organic substances by mineral

materials was aided rather than impeded if the organic body exhibited signs of incipient decay. According to him, an increased affinity between the original organism and the mineral replacing it was produced by that approach to decomposition—whether the pseudomorph was to become calcareous or siliceous. This fact is especially obvious when Silicium is the material substituted for the original organism.

One of the most interesting of the specimens I have met with in connection with this mineralization by lime shows another feature that I have not alluded to, namely, that the matter which has filled up the cavity has, in many cases, a selective power of its own; it will select some tissues to which it will unite itself most intimately, and pass unaffected through others. The case to which I refer was one to which my attention was first called by my very old friend Professor John Phillips. He gave me some nuts from the bog of Warren Pool, Ferrybridge. Now these were ordinary Hazel nuts, and on examining them I found that the outer shell was in the ordinary state of the shells of nuts that we so frequently dig out of peat bogs; but when I came to break this shell and examine the kernel I found that the lime had passed both through the shell and its lining membrane or endocarp without affecting them, but the kernel was wholly replaced by carbonate of lime; not only so, but as Professor Phillips pointed out, the lime must have been deposited gradually, because it actually broke with something of the conchoidal fracture which, as you all know, the kernel of a nut will exhibit when you break it. This, I think, was about one of the very best that I have seen, but numerous similar illustrations have been met with showing the selective power that the lime has; in this particular instance it had an affinity for the kernel of the nut, but none for the shell—it went to the heart of the thing, the attractive element being probably the quasi-colloid protoplasm.

I must call your attention to another most interesting case of the fossilization of plants. I have at home a collection of about 3,000 microscopic sections of fossil plants from the coal measures of Lancashire and Western Yorkshire, varying from seven inches in diameter down to others of small size. The history of these specimens is sufficiently clear. The districts

in which they are chiefly found are those of which Halifax. Huddersfield, Ashton-under-Lyne, Oldham, and Rawtenstall are the principal towns. The district had originally been dry land covered with a forest vegetation, accompanied probably by a rich undergrowth, which combined to form a layer of vegetable matter. This surface sank below the sea level, and was covered up by successive layers of marine sediment in which numerous marine shells are still preserved, and in some of which calcareous concretions are also found. The probability is that water containing carbonic acid has filtered down through the mud containing these calcareous elements, and reached the layer of vegetable matter, the tissues of the component plants not having as yet perished. By the remarkable process of Osmosis illustrated by the late Professor Graham, the water containing lime in solution penetrated these tissues, and not only filled their minutest cavities with that alkali, but invested masses of them in calcareous concretions which for ever prevented any of the agencies productive of decay from reaching their most delicate structures.

The elements composing these protective concretions are chiefly carbonate of lime with a little magnesia and iron.

Leaving the calcified objects, we come to those replaced by Silica, flint, agate, or quartz. Silicified examples of fossil plants are common enough, but in order to understand something of the way in which silicification has been brought about we must say a word or two explanatory of the way in which the Silicium has acted. You are all aware that under certain conditions Silica, or flint, is capable of being converted into a jelly-like substance, the hydrate of Silicium—commonly called water-glass, or colloid; if a small quantity of this colloid Silica is put into a large quantity of water it will dissolve, though it takes an immense amount of water to dissolve a little of the mineral; but if in addition you introduce some alkaline element into the water the solvent power that water has over the Silica is enormously increased, in which state of solution it will readily penetrate the interior of complex organized bodies. It is from Silica in this state, in all probability, that we obtain the well-known numerous examples of silicified woods that exist. Some of you are probably familiar with the fact that at Autun and Saint Croix in France we find fossil plants are so silicified.

When you go to Egypt you find in the desert regions of the Wadys Anseri and El Tih to the south of Cairo, fossilized forests of trees, in some cases with stems 20 or 30 feet in length, all converted into a form of Silica. Short stumps are still standing as if they were growing in the sand. Thus we have here examples where Silica does the same kind of work that lime does elsewhere.

There is always an obvious natural affinity between the Silica and organic bodies; the one has evidently a marked facility for replacing the other. In the case of these fossil plants in many instances the Silica has filled all the cavities, but there is retained, enclosed in the Silica, the tissue that constituted the cell walls and the corresponding walls of the vessels of the plant. In other cases all these tissues have disappeared—nothing is left but Silica, and yet there remain sharply defined the position and extent and arrangement of the carbonaceous tissues, just as perfectly as when the plant was in a living state; one of the most remarkable of the mineralizations of plants.

When we turn to the animal kingdom, we discover some exceedingly interesting cases of silicification. I have put under the microscope two preparations from the Foraminiferous world. You are all aware that the soft animal of a Foraminifer is a mere protoplasmic body—it has no vessels, no skeleton—is nothing but a little speck of jelly-like matter. Speaking of the animal as retained within its shell, a Rotalia begins with a central cell, to which is added a second larger chamber, but connecting it with the first one is a small perforation in the partition separating the two segments, and by a succession of such growths is produced a spirally-arranged group of segments, connected by a succession of minute necks.

These chambers, when the animal was living and at rest, were filled with this protoplasm, using a strict physiological term instead of the now needless one of Sarcode, and we find that the animal occupies all these chambers in the same way.

Now, gentlemen, when you take some of these dried-up Foraminifera that you so often get from foreign regions, you apparently have only the shell, but you can sometimes, after treating this shell with acid, get the dried animal separate from the shell. I have on the table, obtained in that way, a

specimen of the animal of a species of Rotalia from the West Indies, which has drawn in all its threads and tentacles within its chambered house. Take a flint of the Chalk, so common in this part of the world, and with a convenient little hammer chip off the thinnest and smallest flakes of this flint—the thinner they are the better—put them first into turpentine and then successively under the microscope. Persevering in this research, you will accumulate a collection of minute silicified organisms, including Foraminiferous animals, some within and others deprived of their shells. I have on the table such microscopic animal preparations in both these conditions. But I have also on the table a specimen, for which I was indebted, a long time ago, to my old friend and fellow-worker—when we were together investigating the Foraminifera—I mean the late Dr. W. B. Carpenter. It is a specimen demonstrating the existence in the Ægean Sea of what you are all familiar with under the name of "Foraminiferous ooze," but in this particular specimen all the calcareous elements of the ooze are eliminated; but though the shells have gone, the animals are preserved in a silicified state—not imbedded in Silex, but the animals have shown their affinity for Silica by allowing their protoplasm to be replaced by that substance. Just fancy an Amæba capable of being silicified! There would apparently be no difficulty about the silicification of the Amæba if put under favourable circumstances, because it is not more highly-organized than these Foraminifera are. Here we have a demonstration of the close affinity that Silica and animal substances have for one another. But in addition to the above states, we further find in these flints other Foraminifera, in which not only the protoplasmic animal, but also the calcareous shell is replaced by Silica.

On turning our attention to the larger fossils found in the Chalk, we shall discover that the same affinity of Silica for organic matter is shown in a large number of them. Thus, in many of the Echini that you get from the Chalk, such as the genus Spatangus, etc., their shells still retain their normal Carbonate of lime, but the animal in the interior has disappeared and been entirely replaced by Silica.

One more example of mineral replacement may be quoted, in which iron is the replacing material. This is seen most

frequently when the strata in which the fossils are preserved are shales and clays, like the Oxford clays and the Liassic beds on the Yorkshire coast, in which many of the calcareous shells of the Ammonites have been converted into iron pyrites, which, in the old days, we used to call Sulphuret. The calcareous shell is here replaced by this Sulphide of iron. Vegetable substances are equally liable to be replaced by this Sulphide of iron. I have on the table a specimen of a Stigmaria—one of the Sigillarian and Lepidodendroid roots—where the Sulphide of iron has taken the place of everything else. Sections of these things are, under the microscope, as black as ink, but with a common pocket lens you will be able to see minute particles of this Sulphide of iron, not only covering the cell walls on their outsides, but the solution of the metal has passed, by osmosis, through cell walls, and in like manner covered their inner surfaces, whilst in other examples the iron has substituted itself for the vegetable substances. Whether the whole of the organic carbon has disappeared I cannot absolutely determine, but, so far as I can see, there is not a trace of it left. I have tried, by making sections of some of these specimens with a view of discovering whether or not any traces of organic carbon were left, but this does not materially affect the question under consideration. Examples of silicified plants on the table show perfectly clearly there is no carbon there, and it does not particularly matter whether there was any left or not, because whilst in some all the original carbon certainly disappears, in other cases it as certainly does not.

The conclusion to be arrived at from this hasty treatment of a very complex subject will be somewhat as follows :—Numerous objects have either lived in water, or on land which has sunk beneath water. As they died, their remains sank to the sea-bed, and there they became imbedded in the sand, mud, or whatever materials that floor consisted of. Those materials became consolidated into limestone, sandstone, or shale, sandstone being but consolidated sand, whilst shale is mud so altered, and limestone was, in large measure, Foraminiferous and Coralline ooze. Enclosed firmly in one or other of the above consolidated materials, as the sculptor prepares for his metallic casting by enclosing his clay model within its plaster mould, each organism underwent more or less of change. In

some cases, as amongst shells and the bones of animals, these changes were limited to the disappearance of the decomposable organic matter, leaving the mineral elements unaltered. Still further changes depended upon the varieties of local circumstances and conditions existing in each individual case. The imbedded object might undergo no change. It might for a time only have any cavities that existed in its substance, large or small, filled up by inorganic matter introduced into those cavities in a state of solution, and left there either in an amorphous or a crystalline condition.

In other cases, the substances composing the buried organism might be partially or wholly removed, either in a solvent or a gaseous condition, and the vacant spaces be reoccupied by foreign materials as before. All these varying results must have been dependent, partly upon differences in the character of the matrix within which the organism was imbedded, partly in the substances dissolved in the superincumbent water, and partly upon differences existing between the affinities of the substances so dissolved and those of the buried object which they were about to replace.

On Two New Species of Macrotrachelous Callidinæ.

By David Bryce.

(*Read January 20th, 1893.*)

(Plate XI.)

Before entering upon the description of the new forms, I take this opportunity of referring to two points as to which some misconception may exist. The first arises in part from an error of my own. In my former paper on the group of Macrotrachelous Callidinæ I mentioned a species, which is not uncommon, as "the form described by Mr. Milne as the *Callidina elegans* of Ehrenberg." I should have referred to it simply as the *Macrotrachela elegans* of Milne, for, in point of fact, that author, as I have more recently stated, had come to the conclusion that Ehrenberg's genus Callidina represented Philodinæa, having that type of corona which we now recognize as distinctive of the genus Adineta. It follows from this that his two species, *M. elegans* and *M. bidens*, were believed by him to be distinct from the two species of Callidina described previously under the same specific names. Yet Dr. Hudson, regarding all the Macrotrachelæ of Milne as so many species of Callidina (Rotif. Supp., p. 59), proceeds (Index, *ibid.*, p. 64) to refer *M. elegans* to the *Callidina elegans* of Ehrenberg, and *M. bidens* to the *Callidina bidens* of Gosse, being obviously misled by Mr. Milne's unfortunate choice of names Having compared the descriptions given in "The Rotifera" (i., p. 109) with those furnished by Mr. Milne, and having found forms agreeing with both of the latter, I have little doubt that all four species are distinct, and I would suggest that Mr. Milne should remove the present block by bestowing new names upon his forms. I venture to add, as my own opinion, that the fact that a specific name has been already employed should be a supreme objection to its use for a new form of any conceivable propinquity of

relationship, however suitable that name should otherwise appear.

The second point is the use by Dr. Hudson of the term œsophagus in the specific characters given (Supp., pp. 9-10) for *Callidina symbiotica* and *C. Leitgebii*. The former he states to possess an "œsophagus without a loop," the latter, an "œsophagus with a loop." The portion, however, of the alimentary tract where the loop is present in *C. Leitgebii*, is that between the mouth cavity and the mastax, and is better identified as the buccal funnel, gullet, or pharyngeal tube, whereas the œsophagus is that portion following the mastax, and through which the food is conducted in its passage from the mastax to the stomach. As Dr. Hudson himself (Rotifera, i., p. 7) has defined it in this sense, his use of it to denote the pharyngeal tube is clearly a slip.

Callidina symbiotica, therefore, has the pharyngeal tube without a loop, and *C. Leitgebii* has the pharyngeal tube with a loop. So far as I am aware the loop occurs in no other species of the genus.

The occurrence of two more specimens of *Callidina spinosa* enables me to add to my former description of that species that the rami have respectively three and two teeth, giving the formula $\frac{3}{2}$, and that the species is viviparous. The latter character, although possessed by several of the commensal Callidinæ, has not yet been noted among the macrotrachelous group, and the doubt is thereby raised as to whether the species is not in reality a Philodina, in which the eyes have escaped detection. I hope, therefore, that whoever may next find it will look closely for the eyes, for the number of toes, and for the presence of a fœtus. In Philodina the eyes are frequently very difficult to see, from the paleness of the colouring matter; and as this species has a very rough and opaque skin, it is the more possible that they may have escaped my search.

The two new species exhibit extreme departures from the type of ciliary organs normal among the Philodinadæ. For my present purpose that type may be said to consist of two ciliary wreaths, of which the principal is borne round about the peripheries of the dilated and cushion-like tops of two prominent fleshy lobes, placed side by side, and separated by a conspicuous gap. In a directly dorsal view, one observes at the outer lateral bases of

these lobes a collar-like ridge, the dorsal continuation of the margin of the mouth. By measuring the greatest breadth, across the two fully expanded lobes, and again at the edge of this collar, we can classify, with some accuracy, the varying proportions of the ciliary organs.

In Philodina the two discs are usually much wider than the collar, but as we examine the Callidinæ we find a series of gradations passing from the broad Philodina-like discs of *quadricornifera* and other large forms until we reach, in this new species, *Callidina pusilla*, a form in which the discs are barely one-half the breadth of the lip margin. It is no longer the collar which we can measure, we have to take our dimension from side to side of the lip itself. The conspicuous gap between the lobes has disappeared, and there remains but a shallow notch, merging into a shallower groove, to mark the two-fold structure of the almost united discs. The cilia of the principal wreath no longer produce the appearance of a revolving cog-wheel, but rather that of so many lashes, whose free ends are rapidly and independently whirling in circles as though swung round from their respective bases, an appearance probably as illusory as the other. They give the impression of being rather longer and more vigorous, if possible, than usual, as though to compensate for their presumably smaller number. I have not observed the animal attempt to swim, but these cilia, at all events, have no difficulty in fulfilling their important duty of drawing food particles within reach of the secondary wreath. In consequence of the reduced proportions of the discs, and the retained height of their pedicels, the secondary wreath is placed, as to the principal wreath, at a much more oblique angle than is normal. The species which approaches this most nearly in its restricted disc surface is *C. reclusa*, one of the two interesting species found dwelling in the cells of Sphagnum, and it is curious to note that *pusilla* is also a tube-dweller; indeed, it was this species which I referred to in my earlier paper as a tube-dwelling species, which I could not identify.

Recently, however, I have succeeded in establishing a colony in a trough whose sides have become coated with a growth of some very minute alga. Here and there specimens of *pusilla* have formed little tubes, distinguishable by their brown colour from their floccose-like surroundings. It is almost a

euphemism to call these habitations tubes, but in the larger examples there does appear to be an elastic tissue forming the basis of the structure. Externally it is rough, as though coated with and formed by particles brought together by the action of the wheels. I have not, however, observed any movement of the Rotifer suggestive of conscious tube-building, nor have I seen the manner of the disposal of the fæces, which I have thought might perhaps be the cause of the brownish colour of the tube. Individuals without a sheltering tube are occasionally seen nestling among the flocculent growth, but I believe that these are either very young specimens or such as have been recently disturbed or otherwise induced to leave their habitations. Deserted tubes are not infrequent, but are usually small, and often contain a single egg.

My colony has existed for some three months, and, whilst the increase in numbers has been slow, it has been maintained. Yet it has been far outstripped by that of *C. constricta*, a more nomadic form, which has been its table companion in captivity. This suggests that *pusilla* is less hardy, or is less prolific, or that its eggs develop more slowly than those of its competitor, whose eggs, indeed, are deposited wherever the parent may happen to be, and left quite unprotected. The smaller size of *pusilla* and its smaller trochal discs do not, I think, account for the difference, for in the same trough I have several other larger forms with spreading trochal discs, and none of these show any increase at all. *C. pusilla* has one structural peculiarity occurring in several other species, but not mentioned by any other writer than Dr. Zelinka, who has noted its presence in *C. symbiotica*. This is a peculiar hillock-like swelling upon the dorsal surface of the first joint of the foot, arising apparently from a local thickening of the hypodermis. Longer than broad, and placed lengthwise to the body-axis and in the central line, it is best seen in lateral view, when it appears as a low mound rising gently in the front and extending nearly to the hinder boundary of the joint, where it terminates rather abruptly.

In the second new species the trochal discs have become developed into two horn-like processes, which extend forwards, and are so curved as to suggest at once the head of the male of the stag beetle. I propose for it the name of *cornigera*. There have been no forms discovered intermediate between this very

abrupt departure and the type, and I anticipate that ultimately a new genus must be created to receive this species. But I have only found one single specimen, and although I kept it for some fourteen days I failed to get any precise observations of the disposition of its ciliary wreaths. The creature was very timid and sluggish, and on the few occasions I saw the wheels protruded it baffled my efforts by either erecting itself until one could see into the mouth, or leaving hold it would swim away to be presently stopped by coming full tilt against some obstacle. Over and over again it was brought to a stop with its horns against the glass forming the bottom of the cell, and there it would continue for some minutes, the wheels in motion and the foot waving directly in the line of sight. Thus standing either upon its foot or upon its head it constantly frustrated my designs, and I could only obtain approximate sketches and cursory notes.

The lateral edges of the discs are produced forward as two horn-like processes, which at first receding from each other are yet so curved that towards the tips they have begun to approach and do approach as closely as at their bases. For some three-fourths of their length they advance almost in the plane of the body, but from thence they are decurved till they point nearly at right angles to their original plane. I could see no gap between the two halves of the cilia-bearing surface, nor any break in the line of cilia, or in the line of the discs. That portion which most nearly corresponded to the usual trochal discs was here replaced by a somewhat concave surface, the upper margin showing in dorsal view as an approximately straight line joining the bases of the horns. The concavity of this surface seemed to be continued some little way forward along the inner side of the horns, and, as well as I could see, the cilia of the principal wreath were disposed along the whole dorsal margin of the concavity, and, at least, a great portion of the ventral, extending thus not merely across the front, but even some little distance along the inner margins of the horns on either side. I could not define any portion of the secondary wreath nor the form of the mouth cavity. In the act of protruding the wheels one horn was pushed forth before the other, as though in retraction it had been folded across and outside it, both being bent inwards from their bases.

Whenever the wheels were withdrawn there became visible the familiar outline of a Callidina, a little stouter than some forms, but not now presenting any obvious peculiarities.

I noticed that the double flap, terminating the column tip, was rather more developed than usual, but the cilia beneath it were not particularly powerful or conspicuous. The dorsal surface of the column had a perceptible thickening of the hypodermis very noticeable in side view.

The third segment, to which belong the mouth and the trochal discs, seemed a little bulkier than is usual, and the next carried a very short antenna, about one-fourth of the neck thickness.

There were the usual skin-folds, dorsal and lateral, lightly marked, whilst the foot had the ordinary short conical spurs. I did not ascertain the mastax formula.

Callidina pusilla, n. sp.

Sp. Ch.—Small, rather slender, trochal discs, about one-half breadth of mouth margin, sulcus reduced to shallow notch, discs on pedicels rather higher than breadth of discs. Mastax formula $\frac{4}{3}$, food in pellets, digestive action a periodic heaving of stomach, upper joint of foot with mound-like swelling. Spurs, two short cones. Inhabits brownish, rough-looking tubes.

Habitat.—Moss from Epping Forest.

Length.—Largest specimens about $\frac{1}{120}$th inch, extended.

Callidina cornigera, n. sp.

Sp. Ch.—Trochal discs apparently without gap, laterally produced into two horn-like but fleshy processes, whose bases are furnished on inner face with cilia, forming part of principal wreath. Antenna very short, one-fourth of neck-thickness.

Habitat.—Moss from roadside, near Bognor.

Length.—Extended about $\frac{1}{100}$th inch.

Description of Plate.

Fig. 2.—*Callidina pusilla*, wheels protruded, ventral view.
„ 2*a*.— „ „ wheels protruded, lateral view, in tube.
„ 3.—*Callidina cornigera*, wheels protruded, dorsal view.
„ 3*a*.— „ „ lateral view of horns.
„ 3*b*.—Column as extended in crawling.

On a Diatomaceous Earth from Guatemala, and the Occurrence of Marine Diatoms in Fresh Water.

By Arthur M. Edwards, M.D., Newark, N.J., U.S.A.

(Read January 20th, 1893.)

Having received from Mr. G. C. Karop a sample of earth labelled "Diatomite, Guatemala,"* I wish to report on it at this time, more especially as it gives me an opportunity of making known the results I have arrived at in studying the Diatomaceæ in connection with the subject of the occurrence of marine forms in fresh water.

This brings me to speak of the origin of Diatomaceæ, whether fresh water, brackish water, or salt water or marine. The Guatemala earth is a white powder, and, although the geology of it has not been studied, or at least has not been communicated to me,† I should judge from the examination of it microscopically that it is an example of which we have many in the northern United States or Champlain area, that is to say, deposits which have been thrown down during the post-glacial or iceberg period, when the ice formed in the glacial period was melting, and warmer weather succeeded, and a fresh water sea, with Diatomaceæ, lived and died, their siliceous shells being deposited on the bottom. I judge this to be the case by comparison of it microscopically with those deposits with which I am familiar in Canada, the United States, Germany, Great Britain, Italy, and Sweden. It is purely siliceous,‡ and consists of the following forms:—

Amphora ovalis, Ktz.	*Melosira undulata*, Ktz.
Biddulphia lævis, Ehr.	*Navicula affinis*, Ehr.
Cocconeis lineata, Ehr.	,, *bacillum*, Ehr.
,, *placentula*, Ehr.	,, *cryptocephala*, Ehr.

* Obtained from Mr. A. Ashe.

† Mr. Ashe informs me that inquiry has been made on this point but without result.—Ed. "Q. M. C. Journ."

‡ See Analysis at end by Mr Ashe.

Cocconeis Mexicana, Ehr.
Cymatopleura elliptica, var. *Hibernica*, W. S.
Cymatopleura solea, A. de B.
Cymbella cistula, Hempr.
Epithemia gibba, Ehr.
,, *turgida*, Ktz.
Fragillaria virescens, Ralfs.
Gomphonema gracile, Ehr.
Melosira granulata, Ehr.
Navicula cuspidata, Ktz.
,, *dubia*, W. G.
,, *pygmæa*, Ehr.
,, *sculpta*, Ehr.
,, *viridis*, Ehr.
Rhoicosphenia curvata, Ktz.
Surirella biseriata, A. de B.
,, *spiralis*, Ktz.
Synedra ulna, Ehr.

1844. The *Cocconeis lineata*, Ehr., is a large form of *Cocconeis placentula*, Ehr., as is seen plainly in this sample. But the *Cocconeis placentula*, Ehr., in it has the markings coarse, showing the transition into a salt water form, or *Cocconeis scutellum*, Ehr.
552. The *Navicula dubia*, W. G., is plainly a form of *Neidium*, E. P. (E. Pfitzer. Untersuch. ü. Bau und Entwick. d. Bacillariaceen (Diatomaceen) 1871), or *Navicula firma*, Ktz. *Rhoicosphenia*
1790. *curvata*, Ktz., has a *var. marinum*, W. S., which is marine, but this is not the point on which I wish to dwell. What I wish to indicate is the occurrence of *Biddulphia lævis*, Ehr., a form hitherto ranked as marine in this, a fresh water deposit. Now this form is very common in the United States. As marine it occurs on the coast from Cape Cod round into the Gulf of Mexico. As brackish it is found in the salt marshes of Nebraska and other western localities. As a fresh water form it occurs in a pool near Newark, N.J., and in a spring near Coney Island, N.Y.

Fossil it is found in the fresh water deposit of Guatemala, and at Hatfield Swamp, N.J., which I will describe below. And as a brackish fossil form it is found in a deposit called, for want of a better designation, Champlain, near Newark, N.J., and which I propose to describe in a further paper.

1869. *Cocconeis Mexicana*, Ehr., is a very small form, looking like *Navicula exilis*, Ktz., only smaller, with superior valve having median canal, and fastened by the valve to an alga or stone, as is the case with those in the Guatemala Diatomite. In this latter, besides the Diatomaceæ, there is only found fragments of what I have already judged to be pumice. These are common in the Diatomaceous deposits on the Pacific slope, and upon this pumice is the *Cocconeis Mexicana*. This shows that a volcano existed near by where the Diatomite was formed. *C.*

Mexicana, by-the-bye, is *C. Americana*, Ehr., when the striæ are fine, or as Ehrenberg says in the American tabulæ (Abhand. Berl. Ak., 1843, p. 123), "striis obsoletis."

Besides the Guatemala Diatomite I wish to report on a clay from Hatfield Swamp, N.J., which is two miles and a half long by one and a half broad, and three feet eight inches deep, which contains also, besides fresh water forms, such as *Navicula viridis*, Ehr., in its various forms of *nobilis*, *gigas*, and others, and *Eunotia gracile*, *Biddulphia lævis*, Ehr. It has also two truly marine species that have never been found in fresh water; these are *Actinocyclus Ralfsii*, W. S., and *Campylodiscus echineis*, Ehr.

Now the first water that fell was rain, fresh water, and Diatomaceæ grew, died, and their shells were deposited on the floor of the sea, or ocean, as *fresh water forms*. Thereafter the fresh water dissolved the salts that were present, and became marine or what we call salt water. The Diatomaceæ were gradually changed as the water became more and more salt, and became marine species, so that the Diatomaceæ appeared at first as fresh water forms.

ANALYSIS OF A SAMPLE OF DIATOMITE FROM GUATEMALA.

BY MR. A. ASHE.

Moisture	7·610
*Combined Water and Organic Matters ...	6·570
Oxide of Iron (Fe_2O_3)	3·028
Alumina	4·872
Lime	·515
Magnesia	·122
Potash	·104
Soda	·146
Phosphoric Acid	·118
Carbonic Acid	·240
Sulphuric Acid	None
Chlorine	·010
Silica	76·665
	100·000

* Containing nitrogen in the organic matter, ·034.

On a Method of Preserving Rotatoria.

By Charles Rousselet, F.R.M.S.

(Read January 20th, 1893.)

The inability of preserving the various and beautiful forms of pond life in anything like the appearance they present in life, owing to the thinness of their tissues and the enormous contraction they undergo when put up in preservative fluids, has always been felt with much regret by most observers. It often happens also that a form is found in great numbers on one occasion and then not again for many years afterwards, and the utility, therefore, of being able to preserve some type specimen for future reference, and for the elucidation or verification of anatomical details, cannot be overrated.

During last season I made a large number of experiments in order to try and solve this problem with regard to Rotifers. My efforts in this direction have been sufficiently successful to induce me to place before you the methods I have employed, in order to allow others to experimenting the same direction.

The Rotifers I have prepared are fully extended, very nearly as transparent as in life, with their cilia, muscles, nerve threads —and even the minutest anatomical details—such as the vibratile tags and the very fine flagella attached to these tags in Asplanchna—fully preserved, and often rendered more easily visible.

After carefully considering the various methods in use for preserving animal tissues, which are so clearly set forth in Mr. A. B. Lee's "Microtomists' Vade-Mecum," I decided to follow an exclusively watery process, that is, one that would prevent the dehydration of the specimen, which appears to be the chief cause of the shrinkage. Alcohol, therefore, and all fluids absorbing, or much denser than, water have been avoided.

The whole process consists of four stages, namely, narcotizing, killing, fixing and preserving, which I will describe separately.

Narcotizing.—In dealing with Rotifers the greatest difficulty

to contend with is the killing in an extended state; few other animals can contract into such a shapeless mass when we attempt to kill them by ordinary means, such as alcohol, poisons, heat, etc.; even the quick acting osmic acid is not quick enough to prevent a complete collapse. It is, therefore, necessary to have recourse to a narcotizing agent which will act very slowly and paralyze the nerves and muscles sufficiently, that when the killing fluid is added the animals will no longer be able to contract. Such a narcotizing fluid, eminently suitable for Rotifers, has been found in a weak watery solution of hydrochlorate of cocaïn of 1 to 2 per cent., first proposed by E. F. Weber for keeping quiet very active Rotifers when under observation, and for which purpose it answers admirably. If a small quantity of this solution be added to the pond water in which the Rotifers are, they will at first not be affected at all, but continue to swim about as usual. After some minutes (5 to 15) their motion will become slower and slower, and in the most successful cases they will finally sink to the bottom of the trough fully extended, with the cilia vibrating but feebly. The Rotifers will not be dead yet, and if an attempt be made to kill them at once in that state they will most likely contract and be spoilt. It is necessary to watch them under the microscope until the cilia have just ceased to vibrate, and then, at least in the majority of species, is the right moment to kill them, as explained below. The action of cocaïn varies greatly in different Rotifers; some species, such as Asplanchna, can stand a good deal of the anæsthetic, while others, such as Stephanoceros, are extraordinarily sensitive to it. The quantity of cocaïn added to the water must, therefore, be varied with every species according to requirements taught by experience. As a general rule I can say, add as little as possible, but sufficient to kill in about an hour's time; if the animals collapse, or show signs of weakness at once, it proves that too much has been added.

Killing and fixing.—When the Rotifers have been sufficiently long under the influence of the cocaïn they are killed with Flemming's chromo-aceto-osmic acid mixture,* which fixes them

* Flemming's fixing solution consists of—

1 per cent. chromic acid	15	parts
2 ,, osmic acid	4	,,
Glacial acetic acid	1	part

at the same time. It is essential that the animals should not be quite dead when the killing and fixing solution is added. As soon as a Rotifer is quite dead various *post-mortem* changes begin immediately to take place in the tissues, first absorption of water and swelling, then disintegration and decomposition, and it is evident that in order to preserve the animal in its natural state, it is necessary to fix the histological elements before any such changes have taken place. The word "fixing" implies rapid killing and at the same time hardening of the tissues to such an extent as to prevent their undergoing any further change by subsequent treatment with preserving fluids.

The animals remain in the fixing solution a quarter to half an hour, not longer, small Rotifers rather less; then the solution must be washed out with distilled water by changing the water five or six times. The animals will then be ready to be placed in the preserving fluid.

Preserving.—The choice of a suitable preserving fluid has been a matter of some difficulty, and may possibly still be improved upon. The required qualities are, that it should not alter the form and tissues of the fixed Rotifers; that it should not form a deposit or crystals; that it should not attack the cements used for making and mounting in cells; and that it should have a density not differing appreciably from that of water.

Alcohol and glycerine prevent decomposition by absorption of water; this means shrinkage in the delicate tissues of Rotifers, both these fluids are, therefore, unsuitable. Weak solution of corrosive sublimate, 2 in 1,000 parts, has several times produced crystals, and has also attacked Miller's caoutchouc cement, of which my cells are made, and from which it appears to dissolve out some of its constituents.

I have tried various other liquids with more or less success, and have come to the conclusion that the best preserving fluid is simply distilled water rendered antiseptic by a trace of the fixing solution (about 8 drops of Flemming's solution in an ounce of water), giving the slightest possible yellow tinge to the water. Rotifers mounted in this solution for six months have kept very well. The chromic acid appears to give a slight yellowish colour to the tissues, but otherwise they remain very fairly transparent; it is possible, however, that with further experience a still better preservative fluid will be found.

Bearing in mind all that has been said with regard to narcotizing, killing, fixing, and preserving, I will now give a detailed example of my procedure by explaining how I proceed in preserving *Asplanchna priodonta*, and then indicate such modifications as are necessary for other Rotifers, for each species has its peculiarities and affinities, and must be killed in a slightly different manner; for the same reason it will be necessary to separate the various forms, as one will hardly succeed in preserving satisfactorily a number of different species at the same time, but few as well as a large number of individuals of the same species can be treated collectively by my method.

Asplanchna priodonta is usually found in great numbers. After isolating some scores or hundreds in a small trough of clean water I add cocaïn solution by degrees, in all about one-tenth to one-eighth the quantity of the water. This is measured roughly in this way: if I know the trough contains five pipettes full of water, I add one-half pipette full of the solution. The Asplanchna will not mind the cocaïn at first, but after a time their movements will become slower, and in about half-an-hour's time they will have sunk to the bottom of the trough. The trough is then transferred to the stage of the microscope, where it will be seen that the animals are perfectly extended, weakly vibrating their cilia, but otherwise motionless. In order to find out the right moment to kill them, I take out a few from time to time on a slide and add one drop of the fixing solution. As soon as they allow themselves to be killed without contracting a small pipette full of the fixing solution is run down the sides of the trough; the solution being heavier than the water will spread in a layer on the bottom of the trough, covering the Rotifers, killing and fixing them, the majority in a perfectly extended state. They are left there for fifteen minutes, and then must be washed thoroughly with five or six changes of distilled water, either in the same trough or in a test tube, to remove all trace of the fixing solution. The animals will then be ready for putting up in preserving fluid.

Asplanchna priodonta contracts slowly just before dying in the cocaïn solution, and must, therefore, be killed quickly, and before this contraction takes place. *Asplanchna Brightwellii* dies in a perfectly extended state, but must also be fixed before being quite dead to prevent *post-mortem* changes.

Pedalion and the various species of Brachionus, Anurea, Notholca, and similar forms offer no difficulty. *Limnias ceratophylli* stretches as far as it can out of its tube under the action of cocaïn, but then contracts slowly and becomes opaque before dying; the fixing solution must, therefore, be added before the contraction begins, and when the cilia are still in full motion.

Floscularia and Melicerta are very sensitive to cocaïn; add little to the water and fix before the ciiia have ceased to move. After having been under the influence of cocaïn they will not contract when killed quickly.

Stephanoceros is excessively sensitive to cocaïn, and only a trace of it can be added to the water, under the influence of which it must remain for a long time (hours) before it can be killed. The long cilia on the arms seem to retain their vitality the longest, and are thrown in violent and utmost confusion by a little too much cocaïn, even when the animal is no longer able to retract into his tube.

The soft bodied forms of the genera Philodina, Notommata, Furcularia, etc., are more difficult of treatment, and as they are not generally found in numbers, experience in their preservation can only be gained very gradually.

With some Rotifers, especially Euchlanis, I have had no success, whilst I have not yet had an opportunity of experimenting on a number of other species.

I trust, however, that the indications given in this paper will enable many, after gaining a little experience, to preserve the new or interesting forms they may meet with, and that eventually it will be possible to make a complete collection of type specimens of the Rotifera.

PRESIDENT'S ADDRESS.

By the Rev. W. H. Dallinger, D.Sc., LL.D., F.R.S., F.R.M.S., etc.

(Delivered February 17th, 1893.)

Gentlemen,—The rapid movement of time brings us to the close of the fourth year in which, by your courtesy, I have occupied the position of your President. It has been in every sense a pleasant period, and to preside from time to time over your meetings, enriched as they have been by monographs and papers evincing quiet and unostentatious sincerity, and the following discussions, showing acuteness and search for truth, has been to me at once a source of interest and profit.

In receding to-night from the position that I have so long occupied I do so with more than complacency, because of the perfect satisfaction, not only I, but all of us, must have in the suitability, competence, and thorough efficiency of the gentleman by whom I am happily to be succeeded. All of us know in Mr. Nelson a gentleman, a microscopist of the first order, and one whose knowledge of the present position and past development of the instrument is thorough, and after having become by four years of close observation cognizant of the unique and important position occupied by this Club, it is pleasant, whatever my own shortcomings may have been, to find myself succeeded by one who is not only a friend, but a friend whose competence commends itself to all.

In saying a few parting words from this chair, the embarrassment arising from the abundance of the material undoubtedly presents itself, but at the same time there are limits involved in the position more easily felt than expressed.

One may, perhaps, glance briefly at one or two of the incidents connected with a year of direct and associated work in regard to our favourite science. A mere review of the work done by the Club can never be thorough enough to be satisfactory, even if it were needed, but a glance at some of the

results of labour associated with or attributable to the instrument which we claim as our own may not be out of place. And at the outset we have no advance to report either in facilities for the use of the objectives of great N.A. now in existence, nor in the production of lenses of yet higher aperture.

At present we are at a standstill. Mounting and immersion media cannot at present be found which will enable us successfully to use a lens with a numerical aperture of 2·00, or even 1·60; and although there is much help afforded us in the use of pure monochromatic light, enabling us to use achromatic lenses more successfully, and both achromatic and apochromatic lenses with increased aperture, there has been no special advance in this matter during the year; but it should be remembered that this is no real proof that some splendid results may not yet be obtained from the use of shortened wave-length represented by apochromatic objectives.

I have been experimenting on the entire group of my object-glasses, as produced by the best English, European, and American makers, for the last 26 years, and I certainly have obtained most curious and even conflicting results; but the sum of these practically is, that I gather, what I suppose was implied in the first presentation of the facts connected with the scientific use of monochromatic light, viz., that to obtain the highest results possible with it—to secure the largest theoretical and practical aperture with it—we want combinations of lenses having mathematically adapted curves—in short, objectives made to give the best results with a definite ray of the spectrum just as the apochromatic objectives had to be specially devised and figured to do *their* special work. Hence it appears to me that we are not giving monochromatic light a fair chance until we use, for high powers specially, object-glasses constructed to suit its refraction and dispersion. We do not exhaust the new possibility presented by it by simply showing its limitations when applied to *existing* object-glasses.

I should be glad, indeed, if some one of our leading and competent English opticians would address himself to this problem, adapting lenses for use with the spectral ray that will give the widest aperture in ordinary media, such as we can use without violating the conditions which make the life of the organism under examination impossible. There is a fine field open.

Nevertheless, in the construction of highly-corrected lenses of high power, without fluorite, there has been and is a distinct advance, and this is the more important because it means the production of constantly lower-priced lenses with high quality—the very condition needed to promote the progress of microscopy.

And in this relation it would be an impropriety not to remember the valuable contribution to the improved theory and practice of lens-making provided by Professor Silvanus Thompson in his paper to the Society of Arts, on "The Measurement of Lenses," carrying with it as it does a most important "New Focometric Method" and a beautiful newly-devised Focometer.

It is not new, of course, for the optician to make exact measures of optical quantities. Optics involves, as a matter of course, exact methods; but as a rule they are both costly and complicated, and to have relatively easy means of testing with severe accuracy every part of the microscope associated with its optical functions will be to accomplish that most desirable of all things in the interests of many sciences, *i.e.*, make thoroughly accurate and at the same time low-priced microscopes—as well as cameras, telescopes, and other optical instruments—accessible to students.

What is really needed is a uniform system of describing the properties of a lens. For all that is really placed at the disposal of the student through the accessible sources of information, the whole subject might be supposed to be exhausted by considering the particular case of thin lenses. Prof. Thompson shows how all the properties of a lens could be indicated by specifying the position of four points, the two focal points and the two "Gauss points," where the principal planes of the lens intersect the action of it; and by the apparatus he has devised these latter points can be determined in any lens or combination of lenses.

There can be but little question that there is need in the interest of English science for more accurate methods and broader and deeper—as well as special—knowledge on optical matters.

The establishment of an optical laboratory at Kew and elsewhere in this country should be fostered by all who are interested in the production of the highest class optical power in all directions of scientific research. It is time for this

country to arouse itself to its responsibilities and obligations in this direction. There are limits beyond which private enterprise cannot go. It is to German State aid that we are indebted for a considerable portion at least of what has resulted to microscopy by the invention of the Abbe-Schott optical glass, and it is only societies like this that can know efficiently what this means.

A well-equipped optical laboratory would, I believe, inaugurate a new future to theoretical and manipulative optics in England, and in all probability exert a powerful influence on the sciences affected by its progress.

The practical microscopist is often struck with the singular want of knowledge displayed, sometimes in the most unexpected quarters, in the elements of practical knowledge concerning the microscope. During the past year those who were not in possession of more accurate information beforehand might have come to the conclusion that some sweeping advances had been made in the very principles of our instrument, for in a leading scientific journal published in Germany* "a new construction for the microscope" was very gravely announced. It was by Dr. Lendl, who pointed out that the supreme purpose of the microscope having been now accomplished by the construction of immersion and apochromatic systems of object-glasses, it was time to seek to combine with this improved power of definition a much increased magnifying power.

And this charming desideratum is, he tells us, to be brought about quite independently of the objective and without increasing the power of the eye-piece, by what he designates a change in the construction of the microscope.

The eye-piece is removed and replaced by a second complete microscope, so that the image formed by the objective is no longer submitted to further amplification by the eye-piece, but by this auxiliary instrument. By this means it is claimed that far greater magnification in its proper sense is secured, and far less light lost than with deeper eye-pieces.

It was soon pointed out by Mr. Nelson, as it had been pointed out by others, that this was only a more pretentious recurrence of that optical *ignis fatuus* of some years ago, the Aplanatic Searcher.

* "Zeitschr. f. Wiss. Mikr.," viii. (1891), pp. 181-90.

It is a fallacy lying at the root of elementary optics to suppose that any real increase in the working power of the microscope can be obtained by subjecting the primal image of an approximately perfect object-glass to examination by a second microscope or complex combination of lenses. It has been tried with blank failure as the result, sufficiently often, one would have supposed, to have prevented its recurrence now, when the optics of the microscope have something like a complete form.

The magnifications, so-called, are of necessity "empty" and valueless. All they can do is to enlarge the details of the microscopic image which has been brought about by diffraction in the first objective, and, therefore, there cannot, by any possibility, be a single detail added, while the details that the accurate image does disclose must be blurred and tortured tenfold more than when subjected to the legitimate action of well-constructed eye-pieces.

It will never be by means of mere enlargement of the primal image that progress will be made in increasing the powers of the microscope. This can only be done by increasing the capacity of the object-glass to grasp a larger area of diffraction fans, so as to enclose within the image all that is produced by the object; and to that we must look in the future for the only legitimate means of penetrating farther into Nature's details.

Another curious error is presented during the year in quite another way. In a book* by a very respected continental author, which sets itself the task of making simple to the uninstructed the entire diffraction theory of microscopic vision and the practical use of the instrument, there is an inexplicable misinterpretation, or, at least, misapplication of the very theory itself.

By all who have mastered the doctrine of diffraction in its application to microscopic objectives, as enunciated by Abbe, it is unmistakably understood to be an inference from that diffraction theory that wide apertures should accompany high amplification, and that moderate aperture should be the accompaniment of moderate and low amplifications. Abbe says that "a proper economy of aperture is of equal importance with

* "The Microscope." By Dr. Van Heurck. Translated by Wynne E. Baxter. Crosby, Lockwood, and Son, London, 1893.

economy of power,"* and pointing out that when depth dimension is needed in observation, the low or moderate powers are necessary, he then affirms that "no greater aperture should (therefore) be used than is required for the effectiveness of these powers—an excess in such a case is a real damage."† In truth, it appears almost as an axiom of the diffraction theory of microscope vision, that we should employ the full aperture suitable to the power used. That, in short, to over-aperture a given power in an object-glass is to ruin it.

Curiously enough this appears to be recognized in a broad sense in one part of the book in question,‡ but in an earlier page§ the author recommends *now* what he calls the "American thread" as distinct from the "society screw" for low-power objectives, because its larger diameter admits of back lenses to the objectives of greater diameter, "and thus offers certain advantages," while it is said that the larger lenses are easier to make, and the real curvatures are, therefore, approximated more easily to the calculated curvatures. In other words, we are recommended *now* to employ for low powers a gauge greater in diameter than that allowed by the society screw, so as to be able to employ back lenses of greater diameter.

This, in effect, means that we should give greater apertures to low powers—apertures, that is, greater than can be obtained *within* the diameter of the society screw.

Now there was a time when these lenses were experimentally sought, but it was before either oil immersion or apochromatic days. The matter was first mooted in 1879, and the next year a screw or gauge was brought out by a Mr. Butterfield, having a wide diameter, so as to lend itself to a great back lens, and an absurdly large aperture to low-power object-glasses.

Always desirous of obtaining the advantage of any improvement, and deficient then in the knowledge we now possess, I induced Messrs. Powell and Lealand to make me a two-thirds O.G., with as great a back lens as the society screw would admit. I have that glass now, and its over-apertured condition is patent.

What then must it be with an *enlarged* diameter for the

* "Journal R.M.S.," Series ii., Vol. ii., p. 304.
† *Ibid.*
‡ "The Microscope," p. 56.
§ *Ibid.*, p. 49.

back lens for the same or even a lower power? Clearly it traverses the whole genius and meaning of the diffraction theory. It was only in pre-apochromatic days that such attempts as these *could* be made.

Now, in the new era of objectives, we do not seek for any purpose to transcend the society screw, and the apertures easily obtained within the limits of that screw, viz., 0·3 for an inch and 0·65 for a half-inch objective, represent with high probability the greatest ratios of apertures to power that will be produced for many years.

Clearly, then, there must be some egregious oversight in commending greater back lenses than the society screw will admit of in the year 1893, and to an audience receiving instruction in the paramount value of the diffraction theory of microscopic vision.

Turning now, however, to work done by means of the microscope rather than to the instrument itself, a matter of much interest calls for our unbiassed hearing.

It has, doubtless, been known for some time to the members of this Club that Prof. O. Bütschli has been engaged in efforts at an experimental imitation of protoplasm. These experiments are not of an elaborate chemical order, carrying us into the profounds of organic chemistry. By means of quite another kind the great problem is approached: the experiments are of the simplest order, needing only supreme accuracy and care; and after ten years of research work we are furnished with the results.*

Of course it will be remembered that the absolute uniqueness of protoplasm as the only known seat or centre for the properties of life has been maintained for the last twenty years by the leading biologists of the world. Thus Prof. Huxley affirms† that the "properties of living matter distinguish it absolutely from all other kinds of things, and the present state of our knowledge furnishes us with no link between the living and the not living."

But it may be fairly affirmed that if, by experimental methods and careful research, it could be shown that proto-

* "Untersuchungen ueber Mikroskopische Schaeume und das Protoplasma." By O. Bütschli. Leipzig, Englemann, 1892.

† "Ency. Brit.," Vol. iii., p. 679, 9th ed.

plasm, endowed with its simplest life-properties, could be produced mechanically or chemically, or by the co-operation of both chemistry and physics, there is not a scientific man on the earth that would hesitate an instant to give it welcome.

Now it would be a travesty to suppose that the great German biologist even suggests that protoplasm has been made, to say nothing of protoplasm living. But interesting work has certainly been done. His work was based on the formation of foams. When delicate and minute quantities of a substance that will dissolve in water are mixed with a fatty oil and the combination is put into water, the water diffuses into the oil and is deposited in small beads round the soluble substance, forming what Bütschli calls a foam.

Microscopically examined, these particles are relatively large and coarse. To approximate the German professor's work, we must place a layer of good olive oil on a shallow glass vessel; this must be placed in a constant temperature of 50° C. Gradually the oil attains a suitable degree of thickness and viscosity. This is a crucial matter, and only several tests can determine it.

From this, when in the right condition, vesiculate drops are prepared. A little dry carbonate of potash is ground with great care in a small agate mortar. This is breathed upon until the salt becomes slightly moist, and then a drop of the oil is added; the two constituents are then mixed until they become a thick paste. A few drops, extremely minute, taken from this are placed on a thin cover-glass, which has previously had four equally thick pegs of paraffin slightly melted upon it to form legs or supports. A small drop of water is now placed on the centre of a slip of glass, and the cover-glass, with its drops of paste, is laid on so that the paste makes contact with the water. This is placed in a damp chamber for twenty-four or thirty hours, when the whole appears milk-like and opaque.

The preparation must now be well-washed with water. I find that this can best be done by means of a vaccine-tube of water supplied to one edge, and drawn out by blotting paper, or a small bundle of fine glass-blown fibres tightly bound together on the other side.

If the drops are now carefully examined, it is highly probable that they will be seen to change both their positions and their

shapes. If, however, a pressure be used, or still better, a mixture of equal parts of glycerine and water be diffused through it, a strong streaming movement will be seen; but, in my experience, in repeating the experiments, only when on a warm stage of 50° C., and I find that amœboid movements rarely are seen except under pressure.

It thus appears that we are dealing with a very fine froth, consisting of a large number of minute beads of soap dissolved in water, and each enveloped by a thin wall of fluid oil. All such films, when in contact, unite in many-sided figures, as on the surface of the fluid from which a child is blowing bubbles, or with which the work of the laundry is done.

The minuteness of the space between the glass-surfaces causes this mesh-work, so-formed, to take the appearance of a complex cellular tissue, and there are thickenings which take place in the cellular mesh which certainly have a *granular* appearance; but, I may add, that no appearance in the colloid mesh, whether granular or fibre-like or folded, appeared other than as the result of minute hollow beads when sufficiently examined.

There may be an interior relatively large vacuole, and a cellular border with its walls more or less radially arranged, and the whole may flow, retaining all its features. In the drops also there are relatively powerful streaming movements within, reminding us of streaming in both vegetable and animal cells. These are best seen when the glycerine has done its work upon the foam.

It is, of course, explained that these internal movements depend on surface tensions. The surface tension between the oil and the solution of soap is not so great as that between the oil and the water; this ultimately accounts for the streaming movements.

From this it is argued that we have, only in a simpler form, the extremely complex chemical conditions, and active alterations of state constantly arising in protoplasm. It is contended that altered tensions within and outside the cell constantly arise, hence, mechanically at least, arise streaming, alteration of place, and mutation of form.

That all this is extremely ingenious and profoundly interesting no one competent to judge will deny, and the repetition of the experiments is fraught with pleasure and deep instruction. But it would be a grave error to suppose that by any of these

experiments we have come any nearer to the making of actual protoplasm.

The imitation of streamings and amœboid changes and rapid movements of position are all physically explicable, and no matter how apparently complex the thickened portions of the united froth bubbles may appear, they are, by sufficient magnification, resolvable into minuter bubbles. But he must have lenses such as I have never yet been able to touch, or must have a secret in the use of them which I do not know, who can resolve the strange, the at present undefinable, reticulation, radiate, or plexus-like structure of protoplasm into bubbles.

I have examined all the movements of these artificial foams with care and patience, and after years of observation on protoplasmic movement, I find that they differ much and in many ways from the movements seen in living matter. The coexistence of streams in opposite directions is not uncommon in living cells; every observer, indeed, will have noted an occasional sudden reversal of cellular streams, and not unusually the cessation of the stream and its subsequent recommencement. But more than this, the stimulating action of oxygen or electric energy is at once manifest on the living matter, but they are practically inert on foams.

That approximate physical explanations of certain initial movements of living matter, as in white corpuscles, pus-corpuscles, amœbæ, and so forth may have been discovered by ingenuity and effort, by no means proves that the same results are brought about in the same way in living protoplasm, nor do they prove that we are, as yet, any nearer the discovery of the ultimate structure of protoplasm itself.

We are grateful for the light given and the amount of truth disclosed, but a streaming froth and streaming living protoplasm are immeasurably far apart.

When the higher complex chemical nature of protoplasm is considered, side by side with the totally different conditions under which a compound, capable also of being made in the laboratory, is made by living matter, we have surely a strong reason for considering that vital chemistry is at least unique, and that it will not inevitably follow that because delicately made and carefully observed foams simulate the internal and external movements of protoplasm in its simplest form, that, therefore, the phenomena of life are the less difficult to explain.

We must first unravel the mystery of protoplasmic structure before we can venture to claim that we have found an analogue to the simplest movement it exhibits.

I need hardly say that irritability, power of nutrition, and cyclic changes, with power to multiply its kind—the essential features of the simplest living cell of protoplasm—are not even suggested as properties of these most interesting foams.

A subject that must command, from a society like this, quite as large an interest as the above, is the demonstration now held to be completely established that it is to bacterias—pecies of "micro-organisms"—that some of the most obscure and important phenomena in agriculture are due.

In the early part of 1891 M. Pasteur published some most interesting results obtained by Herr Winogradsky by experimenting with soil taken from all quarters of the world,* enabling him to conclude that two organisms are employed in the nitrification of the soil, by which plants obtain their nitrogen. He had previously shown † that the nitrifying process was effected by a single species of bacteria which was called Nitromonas, but later he satisfied himself that there are important morphological differences in these organisms, and they were classed in a group of nitro-bacteria, the common characteristic of which is the oxidation of ammoniacal nitrogen. He now concludes that two organisms are employed in natural nitrification, one forming *nitrite* and the other *nitrate*, and consequently the process is completed in two periods. Both these organisms he succeeded in isolating, the nitrate-former, which is oval, about 0·5 of a micron long, and about two times less in breadth; the nitrite-forming organisms are oval or globular and about double the size of those which form nitrates.

In normal earth, nitrate only is formed, the production of nitrous acid being a transitory phenomenon, and, even in the presence of considerable quantities of ammonia, being oxidized as soon as formed. The nitrite ferment, either under natural or under artificial conditions, can only form nitrite, and nitrous acid thus formed remains as such in the ground if the *nitrate*-former be absent.

If the nitrate ferment as well as the nitrite, however, be added the process is completed in the ordinary way, only the

* "Annales de l'Institut Pasteur," 1891, p. 577.
† *Ibid.*, p. 92.

merest traces of nitrous acid appearing. It is interesting to know that the discovery and isolation of the former of these two organisms thus discovered had been, with much care and by long effort, isolated, identified, and published a month before Winogradsky's earlier paper appeared, by Professor Percy F. Frankland, F.R.S., and he has pointed out the full details of the subject.*

It has long been admitted that one of the most essential sources of nutrition found by plants in the soil is nitric acid. The agriculturist could grow no crops without this, however otherwise complete the soils might be.

Still it is found on analysis to be most minutely present even in ordinary fertile soils. This arises from its eager consumption, when present, by plants, and its being washed out by rains. But the soil under ordinary circumstances constantly generates nitric acid from the many nitrogenous manures placed upon it, and it is in the form of nitric acid that the nitrogen of manures obtains access to plants. This was proved sixteen years ago by showing that the nitrifying process—the production of nitric acid in the soil—is stopped by all those materials known as *antiseptics*, as well as by heat and other agencies inimical to life.

Later it was shown that the process of nitrification could take place in solutions destitute of organic matter.

In 1886 Professor Frankland and Mrs. Frankland employed this method, in order, if possible, to isolate this special organism, and they carried on a process of nitrification over a period of more than four years, without the organism itself being supplied with any organic food. But they succeeded, as Winogradsky did, in separating a nitrifying organism, but only one which had the property of converting ammonia into *nitrous* and *not into nitric acid.*

Of course the change from ammonia into nitrous acid is as a result in organic chemistry much more difficult to accomplish than the change from nitrous acid into nitric acid. So then the vital process of oxidation must be quite distinct from that effected by purely chemical agents.

In the later researches of Winogradsky, to which we have

* Friday evening discourse at the Royal Institution, February 19th, 1892, "Nature," Vol. xlvi, p. 135, *et seq.*

referred, he succeded, as we saw, in isolating a micro-organism which only possesses the power of converting nitrous acid into nitric acid; it cannot attack ammonia and convert it into nitrous acid. The former may be called the nitric ferment, and the nitrification of the soil with its aid is clear. It is brought about by two independent organisms, the first producing nitrous and the second nitric acid.

The scanty presence of nitric acid in the soil does not, however, prevent Professor F. Frankland from suggesting that the immense deposits of nitrate of soda in the rainless districts of Chili and Peru are the result of "a gigantic nitrification process at some previous period of the earth's history," and that "the nitrifying organisms then and there" must have been endowed with "very much greater powers than they possess to-day." Moreover, the nitrifying organisms now found can build up living protoplasm in a solution from which organic matter has been rigorously excluded; and, therefore, can only have been elaborated by carbonic acid as the source of protoplasmic carbon, and from ammonia, and nitrous or nitric acids as the source of protoplasmic nitrogen—and if this be accurate and is subsequently confirmed it represents a new phase in our knowledge of the functions of plants without chlorophyll.

In the same way there is an excess of nitrogen in *leguminous* crops which cannot be accounted for by the combined nitrogen supplied to the land in the shape of manures and in rain water; but it has been shown that this excess of nitrogen is largely dependent on the presence of certain bacteria flourishing in and around the roots of these peas, beans, vetches and their like, and these tuberosities are found, not only to be rich in nitrogen, but to harbour swarms of bacteria.

We have long been accustomed to think of bacteria as active agents in putrefaction, and the various ferments; to be the virus of many and terrible diseases in man and animals. Nay, they infest the water we drink, the food we may eat, even the tobacco we smoke, the butter of our breakfast tables, and the very air we may breathe; but it is a comparatively new *rôle* for their activity that the essential processes of vegetable physiology are brought about by their agency, redeeming to some extent the adverse influences they so generally exert.

Note on Wenham's Method for obtaining an Oblique View of a Microscopic Object and on Marshall's Zoophyte Trough.

By J. E. Ingpen, F.R.M.S.

(Read June 17th, 1892.)

Mr. Ingpen made some remarks with reference to his exhibit of Diatoms and Lepisma scales, shown by Mr. Wenham's method of obtaining oblique vision of surface markings. For this purpose a slip of glass about $\frac{4}{10}$ of an inch wide was ground and polished at one end to an angle. The objects were scraped up with the knife-edge, and another similar slip pressed against it to recompose or neutralize the colour, the light thus entering and issuing at right angles to the slip. The angle for dry lenses must be less than 40°, about 35° being suitable; for balsamed objects 45° would be preferable.

The objective, if of large aperture, must be adjusted for each thickness of the upper prismatic edge, according to the position of the object.

The Diatoms shown were immersed in cedar oil; the Lepisma scales were dry.

The original paper will be found in the "Monthly Microscopical Journal," Vol. xiii. (1875), p. 156.

Mr. Ingpen regretted that so valuable a method of observation should have been so little employed. He himself only remembered it somewhat recently upon coming across some of the prisms he had purchased in 1875. Independently of its assistance in the solution of problems of insect-scale structure, etc., its use in determining the real forms of diatoms and other organisms, by viewing them in an oblique direction, was of importance. Messrs. Ross and Co. had not now any of the prisms on sale, but there would be no difficulty in getting them made, if there were any demand for them, as Mr. Wenham had given full directions for their construction.

Mr. Ingpen also exhibited and described a zoophyte trough

and open cell which had been introduced by Mr. W. P. Marshall so long ago as 1869, and which he thought, like the apparatus just described, had fallen into unmerited disuse. It was simply a cell, of any required dimensions, cemented to a glass slip, and only *half* covered with thin glass. When inclined it could be used as a zoophyte trough; when laid flat half of it was an open cell, the wall around it preventing the escape of objects or fluid, so that dissections could be made or objects arranged and returned into the covered half for examination. Mr. Marshall's paper is reprinted in the "Monthly Microscopical Journal," Vol. i. (1869), p. 239.

In answer to a question, Mr. Ingpen said that he had no difficulty in cleaning the troughs with a curved stick or wire, or a long camel's-hair pencil, or, for the shallower cells, a piece of folded paper, wetted with water or alcohol.

Note on a New Spherometer.

By E. M. Nelson, F.R.M.S.

(Read October 21st, 1892.)

This spherometer made by Mr. Curties from my design differs from others because the lens to be measured is placed on it, instead of the spherometer being placed on the lens.

The usual three points are dispensed with, a ring being substituted, which is cheaper to make as well as more accurate.

The ring, which is held in a tripod stand, has, passing upwards through its centre, a micrometer screw having fifty threads to the inch, and the usual drum-head reading to $\frac{1}{10000}$ inch.

To use the instrument the drum-head is first brought to zero by means of adjusting screws and a glass "plane surface." The lens is then substituted for the "plane surface," and when the hemispherical polished steel head of the micrometer screw is just brought into contact with the lens the reading is taken.

There are three rings of different diameters to suit lenses of various sizes.

The reading of the drum-head shows the length of the versed Sine V, from which, when the chord C is known, the value of R, the radius, may be found by the following formula:—

$$R = \frac{v^2 + \left(\frac{c}{2}\right)^2}{2\,v}$$

By making C a root, the computation becomes one of mere inspection, as $\frac{1}{v}$ can be taken out of a table of reciprocals.

Thus if $C = \sqrt{8} = 2{\cdot}82843$ inch,

$$R = \frac{v}{2} + \frac{1}{v}.$$

When $C = \sqrt{2} = 1{\cdot}41421$ inch,

$$R = \frac{1}{4}\left(2\,v + \frac{1}{v}\right)$$

And if $C = \sqrt{\cdot 2} = {\cdot}447214$ inch,

$$R = \frac{1}{40}\left(20\,v + \frac{1}{v}\right)$$

These are the diameters of the three rings in the instrument before you.

Extract of a Letter from Dr. V. Gunson Thorpe, R.N., China Station, Dated 19th Sept., 1892.

(Read by Mr. G. Western, November 18th, 1892.)

Doubtless you will be glad to hear from an old friend, and of the progress of Rotiferous research in this far-off Empire. My ship is lying at Wuhu, a Chinese city on the banks of the magnificent Yangstze Kiang river, 26 miles from its mouth. China is simply a paradise for the microscopist, and the life in its fresh waters has, I believe, been wholly untouched. Standing at a given point anywhere on the plains of China one is surrounded on all hands by scores of ponds, in which grow the splendid Lotus Lily. The fields are intersected by dykes for irrigation purposes in all directions. Here, if anywhere, the links connecting the different species and genera will be found, and some, if not many, of the existing genera will have to be materially altered to admit the new Chinese fauna. I am flattering myself that my next paper will cause somewhat of a sensation amongst our community of Rotifer hunters. To enumerate some of the new discoveries in China I have found a magnificent Melicertan, with *eight* lobes to its corona, and for which, of course, a new genus will have to be created. I have found in the rice fields of Wuhu a new species of Trochosphæra, in which the globe is unequally divided by the ciliary wreath. Also a Rotifer with a corona not unlike *Lacinularia socialis*, but with four bullæ round its neck like *Megalotrocha alboflavicans.* A Rotifer has been found with a corona distinctly that of Megalotrocha, but with no bullæ round the neck. It constructs for itself also a mucous tube—a Megalotrocha or Lacinularia (I have not quite decided which), the ventral surface of which is covered with prickly spines. Also a new Notops. *Megalotrocha semibullata* swarms in nearly all the ponds here. Now I have to confess an error. I have found once again *Rhinops (?) orbiculodiscus.* It possesses a deeply-set dark crimson eye. How on earth I came to overlook it when I

found this Rotifer in Ireland I cannot conceive. Of course it is not a Rhinops, and as far as I can see at present it ought to be placed in a genus by itself. The only excuse for my error is that at first I did not possess an Abbe condenser, which I do now, and which, of course, makes everything more distinct under high powers. The Rotifer is a very small one ($\frac{1}{170}''$ in length). Some of the clusters of the Chinese Lacinularia and Megalotrocha are simply enormous, quite a quarter of an inch across, hanging like white bits of wool from the stems of the water plants. I should say that some consisted of quite 200 individuals. I think the time is not far distant when something will have to be done with these two genera; probably one of them will have to be done away with, and the two amalgamated. If you care to make any use of this letter at the Quekett Club you are quite at liberty to do so. . . . I always look back with pleasure to the evening I spent at the Club, where I met so many interested in the same pursuit. . . . The Journal which reaches me regularly gives me a good deal of information of your excursions. I wish I could join you. . . .

An Improved Form of Dr. Edinger's Projecting Apparatus.

By E. M. Nelson, F.R.M.S.

(Read November 18th, 1892.)

This instrument, which has been made for me by Mr. Curties, is similar to that suggested by Dr. Edinger in the "R M.S. Journal," 1891, p. 812. I have, however, made one or two trifling alterations, by which an increase in the illumination of the image is secured, which adds to its efficiency. It consists of an upright brass rod* holding a short horizontal tube, at the end of which a mirror is placed at an angle of 45°. Below this, for a condenser, is fitted one of my aplanatic bull's-eyes, the elements of which can be used either singly or together as occasion requires. The stage, which is also horizontal, is placed below the condenser, and is fixed to a separate piece, which carries also the projection lens with its rack work. This arrangement permits both the stage and projecting lens to be together moved from the condenser, while the projecting lens has an independent movement to and from the stage. A wheel of diaphragms is placed above the stage. The source of illumination should also have an aplanatic bull's-eye, and should be one foot distant from the condenser.

This instrument not only shows low power objects very effectively, but also is most useful for drawing them. As the image is inverted and transposed the drawing will be precisely like the original.

* The brass rod has since been altered to a wooden board.

Note on the Construction of the Lorica in the Genus Brachionus.

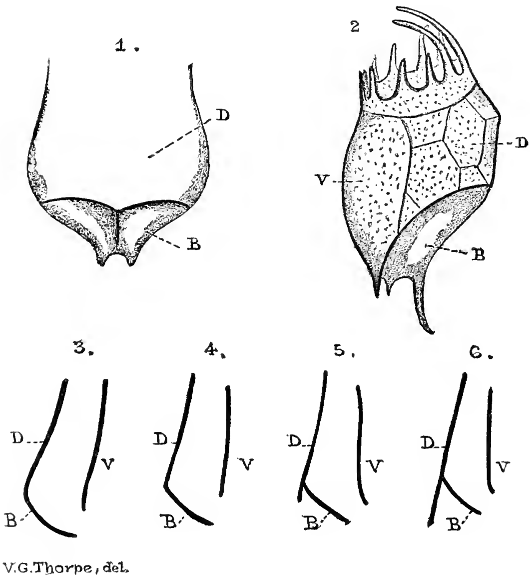
By Surgeon V. Gunson Thorpe, R.N., F.R.M.S.
(H.M.S. "Peacock," China).

After careful examination of many of the known species of Brachioni, as well as many new species and varieties found in tropical countries, I have come to the conclusion that the so-called dorsal surface of the lorica in reality consists of two plates, instead of the one antero-posteriorly curved plate as generally received. This doctrine, it seems to me, has been strengthened by many new discoveries since the valuable monograph on the "Rotifera" was first issued. My proposition, therefore, is this, that the lorica of a Brachionus be in future described as consisting of a *ventral*, a *dorsal*, and a *basal* plate, the latter two constituting what is now known as the dorsal surface. I consider that I am supported in this view by the following considerations: The so-called dorsal surface of the lorica in *B. rubens* (Fig. 1), *B. urceolaris*, and other species is divided in the majority of individuals by a very sharp line of demarcation at the junction of the upper two-thirds with the lower one-third, where the lorica curves to join the ventral surface posteriorly. No doubt there are cases in which the division of the dorsal surface into a dorsal and basal plate is not so well defined (Fig. 3), but I think that these cases are in a minority. In *B. militaris* (Fig. 2) and also in *B. quadratus* one sees the basal plate extremely well defined. But the argument is still further strengthened by the fact that I had the good fortune to discover in 1890, at the Cape of Good Hope, a Brachionus (*B. furculatus*), in which the dorsal plate was prolonged posteriorly (Fig. 6) so as to form a wedge-shaped space between the lower portion of the dorsal plate and the basal plate, in which space parasitic infusoria took up their abode.* Since then I have come across in Ceylon and China transitional

* "Journ. R. Micros. Soc.," 1891, p. 302.

stages of this construction. In a Brachionus (Fig. 5) found in Colombo the dorsal plate was distinctly prolonged, but only to the very slightest extent, whilst the basal plate was well defined, evidently the first stage in the production of a distinct species. Such a prolongation of the dorsal plate, concurrently with the existence of a basal plate, would obviously be impossible, unless each were separately developed.

I venture to send this note on the subject in the hope that by discussion, and more especially by a careful examination of varieties, a solution to a puzzling problem may be attained. In addition to sketches, I beg also to forward a rough paper model of the lorica of a Brachionus found in China, Australia, and Ceylon as a typical specimen.



EXPLANATION OF PLATE.

D. Dorsal plate. B. Basal plate. V. Ventral plate.

Fig. 1.—Dorsal surface of *Brachionus rubens*, showing the division into dorsal and basal plates.

, 2.—Side view of *Brachionus militaris*.

Figs. 3, 4, 5, and 6.—Diagrammatic longitudinal antero-posterior sections of :—

Fig. 3.—*B. rubens;* line of demarcation between dorsal and basal plates ill-defined.

,, 4.—*B. rubens;* line of demarcation between dorsal and basal plates well-defined.

,, 5.—A species of *Brachionus* found in Ceylon, with commencing prolongation of dorsal plate.

,, 6.—*Brachionus furculatus* from South Africa; the dorsal plate greatly prolonged.

Fraunhofer Applies his own Diffraction Theorem to the Microscope.

A Note by Edward M. Nelson, F.R.M.S.

The following very important quotation with regard to the above subject will be found in the article "Light," by Sir John Herschel, Bart., in "The Encyclopædia Metropolitana" (1845), Vol. ii. (Mixed Sciences), p. 490, art. 758 :—

After a description of the means employed by Fraunhofer to measure the angular divergence of diffraction spectra, there follows a discussion of his well-known law, derived from those measurements, where it is shown that, when the elements of which a grating is composed are at a distance less than one wave length from one another, sin θ becomes greater than unity, an impossible quantity, so that when the medium is air and the pencil is direct, *i.e.*, perpendicular to the plane of the grating, no spectrum can be given off.

Sir John Herschel then says : "Mr. Fraunhofer seems inclined to conclude further, that an object of less linear magnitude than λ can, in consequence, never be discerned by microscopes as consisting of parts, a conclusion which would put a natural limit to the magnifying power of microscopes, but which we cannot regard as following from the premises."

From this passage I judge that Fraunhofer had discovered that the admission of spectra of the first order within the aperture of a microscope was essential for the visibility of resolvable detail.

In Memoriam.

HENRY F. HAILES,

Born September 13th, 1827: Died October 21st, 1892.

Since the issue of the last number of the Journal of the Club, we have lost, by death, the services of our esteemed Editor and Honorary Foreign Correspondent, and it would not be fitting that this, the first number issued since his death, should reach the hands of the members of the Club without containing some tribute to his worth. It would have been extremely easy to find a member of the Club much better fitted than myself to write such a tribute, but it would be difficult to find one who entertained a warmer regard for Mr. Hailes, or who was under greater obligations to him.

Henry F. Hailes was born at Camden Town on the 13th September, 1827. His father does not seem to have taken a great deal of trouble either about his education or about giving him a start in any business. Most of the large store of knowledge, upon many subjects, that he possessed, seems to have been acquired here and there and by following the bent of his own inclinations. His oldest friend was a Mr. William Croft, and, as the story of the way in which their acquaintance was formed reveals somewhat of Mr. Hailes' character and pursuits at the time, I may be pardoned for telling it here. Croft and Hailes, both boys, lived near together in Camden Town. One day the former laid a train of gunpowder upon a garden wall, and was about to fire it, when Hailes came up on the opposite side of the wall and blew the gunpowder away. Croft jumped over the wall, and, although much the smaller boy, commenced to belabour Hailes, when the latter, who was very fond of experimental chemistry, said, "Don't let us fight, and I will tell you how to make gunpowder." This he did, greatly to the delight of the younger boy. The two became fast friends from that day and continued to be so up to the time of Hailes' death.

Mr Croft, in telling the story, adds that the reason Hailes gave for not defending himself was, that he was always afraid to strike a boy smaller than himself lest he might injure him.

Mr. Hailes' first entry upon a settled occupation seems to have been made when he went to Collard's as a substitute for this same Mr. Croft to complete his apprenticeship, Mr. Croft's health having broken down and his finding a substitute being the condition of his release. Here he acquired that skill in the use of tools and that liking for mechanical work which not only helped him immensely in the business he subsequently followed, but was to him a never-ending source of pleasure and profit at home. Many a time have I, too, profited by this mechanical skill, both by receiving advice and instruction upon work I have myself had in hand and by getting parts of it which were beyond my skill done for me. Fond, however, as he was of mechanical work, I don't think my friend was altogether happy at Collard's. He, however, made the acquaintance of a Mr. Basire, who gave him some lessons in mechanical drawing, and Hailes and his friend Croft (who was then in Collard's tuning department) diligently worked at this subject together. When he had acquired a good deal of skill in this way, Hailes, then about twenty-five years old, answered an advertisement for a draughtsman in Messrs. Newton's office in Chancery Lane. He obtained this appointment, gave up the pianoforte making, and remained with Messrs. Newton down to the time of his death.

Mr. Hailes was one of the eleven men who attended the first meeting of the Club at Piccadilly on the 14th June, 1865. Of these original members only three now remain upon the Club list, namely, Mr. W. M. Bywater, Dr. M. C. Cooke, and Mr. Edward Jacques. Some of the others are still living, but do not retain their membership of the Club. During the twenty-seven years of the Club's existence Mr. Hailes held some office in the Club in every year except the first, on many occasions holding two offices at once. He has been Vice-President (twice), Member of Committee, Member of Exchange of Slides Committee, Curator, Honorary Secretary (with Mr. Ingpen), Honorary Secretary for Foreign Correspondence, and for the last nine years (while still filling the latter office) has ably edited the Club's Journal. In the first year of the Club's existence his name appears among the donors of slides, and he

has given many others at intervals since that time. He designed the lamp shade which, in a modified form, is still in use upon microscope lamps, and, in 1877, designed and brought before the Club a very useful machine for cutting both hard and soft sections. Although interested in every branch of microscopy, and possessing more or less knowledge upon every branch, he had devoted himself for many years almost entirely to the study of the Foraminifera, and of beautifully mounted slides of these, as well as of foraminiferous material, he possessed a large and valuable collection.

Until attacked with the disease which caused his death he does not seem ever to have had any very serious illness, at any rate after his marriage. He had, however, for years suffered intensely, and at somewhat frequent intervals, from hemicrania, and was often quite prostrated by the violence of these attacks of headache. On Saturday, the 15th October last, he returned home from the City apparently in his usual health. A window had been broken at the back of the house in which he lived, and Hailes, who liked, as far as possible, to do all the work about his home for which most people employ the British artisan, set to work to repair the damage. A cold north-east wind was blowing, and the job occupied rather longer than usual because of his breaking one pane of glass and having to get another. It was, doubtless, while doing this that he caught the chill which caused his death. On Sunday he did not go out all day, feeling less well than usual, and being troubled with toothache; but on Monday he felt better and got up to go to business as usual. Before starting, however, he had a violent fit of shivering and returned to bed. On Tuesday he again got up; but the doctor, who was then called in, sent him again to bed. An examination showed that he was suffering from a sharp attack of pleurisy and pneumonia, and that his heart was also weak; at that time, however, the doctor hoped to be able to save his life. On Wednesday he was much worse, and on Thursday afternoon he evidently felt that his end was near. He then took leave of all his family, being quite conscious, and speaking to each one individually. In the evening he rallied a little, though breathing was extremely difficult, and the heart was not only weak, but had become displaced by his starting up in bed. During the night, however, he became weaker until, just before eight on Friday morning, he passed

away. Although wandering in his mind occasionally, he was conscious and sensible at intervals to within half-an-hour of his death, and, even when his disease had made great progress, was still anxious about his duties in connection with the next issue of the Club Journal. He was buried at New Southgate Cemetery on the 25th October, in the grave in which his mother had been laid only about a year and nine months before.

From no one of its members has the Club received services as varied and continuous as from Mr. Hailes, and no member of the Club has ever been more ready to place his knowledge at the service of beginners in microscopy than he. I, like many others, received my first start with the microscope as well as much subsequent help and guidance at his hands. In connection with "The Crouch End Scientific Society" he started a class of instruction for beginners in microscopic work, and this was only abandoned when it became evident that its members lacked either the time or the inclination to apply themselves seriously to the business in hand. Nothing but dire necessity ever kept him away from the meetings of the Club, and it will be long before members will cease to miss his presence and help. His abundant knowledge upon all those matters which belong to what one may call the practical side of life, was always at the disposal of the Club or of any of its members who needed it; and he was constantly telling one where to buy this, and another how to do that. He was of a very modest and retiring disposition, full of quiet humour, and possessed the most even temper of any man of my acquaintance. Whether at home or abroad, ill or well, busy or at leisure, he was always the same, always ready to be of service, always pleasant and agreeable. To the business of the Club he was most devoted, and, fond as he was of cycling in a quiet way, he could not be persuaded to indulge in a ride until all demands of this nature had been met. With him I have visited most of the prettiest spots in North Middlesex, South Essex, and South Herts, and his keen appreciation of their beauties added much to the enjoyment of these visits. When they are repeated the pleasure will be greatly diminished by being unshared. Our friend's place is empty and will be difficult to fill.

CHARLES EMERY.

PROCEEDINGS,

June 3rd, 1892.—Conversational Meeting.

The following objects were exhibited :—

Lophopus	Mr. F. W. Andrew.
Diatoms from Guatemala	Mr. A. Ashe.
Teeth of Leech, *Hirudo medicinalis* ...	Mr. E. T. Browne.
Asplanchna Brightwellii	Mr. W. Burton.
Abies grandis, Trans. and Long. Sec. ...	Mr. G. E. Mainland.
Crystalloids of undescribed *Tunicated Ascidian*, from Australia, unique specimen	Mr. B. W. Priest.

June 17th, 1892.—Ordinary Meeting.

Dr. W. H. Dallinger, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following members were balloted for and duly elected members of the Club :—Messrs. Charles Bates, Ernest Benest, Geo. Chaloner, F.C.S., Thomas Davies, L.R.C.P.Ed., M.R.C.S., Daniel Finlayson, Arthur B. Hoskings, A.M.Inst.C.E., F. R. Dixon Nuttell, Edward B. Pressland, and Charles Turner.

The names of four candidates were read and suspended until the next meeting.

The additions to the library were announced.

The Secretary said he should like to direct the attention of members to some little books published by M. Paul Dupont, 4, Rue de Bouloi, Paris. They were pocket floras, and three had been issued up to the present. 1. "A General Flora of the Paris District;" 2. "Flore des Champignons;" and 3. "Flore des Mousses." The two latter, he thought, would be found very useful. There was a general introduction, and a complete

diagnosis of the genera and species, illustrated by very numerous tiny, but exceedingly clear figures. The printing also was most beautifully done. These books could be obtained at Messrs. Dulau's, Soho Square, and were quite inexpensive—five or six francs—and easy to read. Other volumes were to follow.

Mr. H. W. King read a paper on *Monstera deliciosa*, a climbing plant of the genus Araceæ, order Spadicifloræ, possessing some peculiarities of structure, of microscopical interest. The paper was illustrated by well-executed coloured diagrams.

The President said Mr. King's communication was of considerable value, and had evidently been very carefully worked out; but from the great detail in which the interesting points had been examined, some amount of study was necessary to quite follow it out, which they would be able to do when printed in the journal, and he was sure those who had listened with attention to Mr. King's paper would desire to pass him a very cordial vote of thanks for it, which was done.

Mr. Ingpen read a note on Mr. Wenham's method of obtaining oblique illumination of structures, such as scales and diatoms, under high power. This was brought out as long ago as 1875, and by reminding the members of it, perhaps some of them would further experiment with it. The simple apparatus was exhibited, and its use explained by a drawing on the board. Mr. Ingpen said there was another small appliance, which, he thought, had undeservedly fallen out of use, viz., Marshall's zoophyte trough or life-cell. It was made by fixing any sized circular cell to a slip, and cementing over one-half of this cell a semi-circular piece of thin glass, thus it could be used as an ordinary trough when inclined, or an open cell when lying flat.

A Member thought perhaps it had been neglected from the difficulty there might be in cleaning the covered in part; but Mr. Ingpen said it was quite easy to clean under the thin glass by a camel-hair brush or strip of blotting paper.

A vote of thanks was passed to Mr. Ingpen.

The President reminded members that this was the last meeting of the session, and he wished them all a pleasant vacation, with the hope that it would be spent in providing material for discussion on future occasions.

The usual announcements were then made, and the proceedings terminated.

The following objects were exhibited :—

Plumatella...	Mr. F. W. Andrew.
Noteus quadricornis	Mr. W. Burton.
Diatoms shown with Wenham's oblique vision method ...	Mr. J. E. Ingpen.
Notops ruber, Hood, n. sp.	Mr. C. J. Machin.

A new *coloured* Rotifer was exhibited by Mr. G. Western.

July 1st, 1892.—Conversational Meeting.

The following objects were exhibited :—

Madreporic Plate of *Asterias rubens* ...	Mr. E. T. Browne.
Hydalina senta	Mr. W. Burton.
Notops ruber	Mr. C. Rousselet.

July 15th, 1892.

The following objects were exhibited :—

Draparnaldia glomerata	Mr. F. W. Andrew.
Stephanoceros Eichornii	Mr. W. Burton.
Section of some Calamarian Fruits from Lower Coal Measures of Lancashire and Yorkshire ...	Prof. Williamson.

August 5th, 1892.—Conversational Meeting.

The following objects were exhibited :—

Megalotrocha albo flavians	Mr. F. W. Andrew.
Marrow-bone Starch Grains of *Euphorbia splendens*	Mr. H. Morland.

September 16th, 1892.—Ordinary Meeting.

Dr. W. H. Dallinger, F.R.S., President, in the Chair.

The minutes of the meeting of June 17th were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. F. W. Eyre, Mr. W. H. Hardy, Mr. Stanley von Lösecke, and Mr. H. S. Martin.

The following were proposed for membership:—Mr. J. Luscombe Luscombe and Mr. Thomas W. Hinds.

The following donations were announced:—

"Proceedings of the Geologists' Association"	From the Association.
"American Monthly Microscopical Journal" (two numbers)	" " Editor.
"The Botanical Gazette" (two numbers)	In Exchange.

"Proceedings of the Belgian Microscopical Society."
"The Microscope" (two numbers)
"The Essex Naturalist" (two numbers)

The thanks of the Club were voted to the donors.

The President said that the agenda that evening did not present any plethora of matter, very few communications having yet been received, many members being, no doubt, still absent on their holidays.

Mr. David Bryce read a paper "On a new species of Adinetæ," from Moss.

The President, in proposing the thanks of the Club to the author, said he was sure the subject was one which would prove of great interest not only to the members of the Society, but to all who had made the *Rotifera* their study.

Mr. J. E. Ingpen wished to call attention to a note which was printed in the last number of the Journal as to one of the high refractive media for diatom mounting. It was a variation made by Father Thompson on Professor Hamilton Smith's medium. It was first made some years ago, but the formula was not at the time disclosed, but after some little persuasion it had been communicated, and was published, as mentioned, but (to save time) without having previously been before them at a meeting. He therefore referred to it in order that it might appear on their minutes. From experience it certainly seemed to have stood remarkably well though its refractive index was so high, and he thought they were to be congratulated in being now in the possession of as fine a mounting medium as anything which Professor Hamilton Smith had himself made.

Mr. H. W. King read a paper entitled "Brief observations on Pond Life from the West Indies," the subject being illustrated by diagrams.

The President said they had in this paper an instance of how much was sometimes to be gained by observations in even the most unlikely quarters, for it might well have been supposed that water of that kind after travelling so far would not be likely to furnish much of any interest.

Mr. Western said that the subject had particularly interested him because he had repeatedly found Bdelloid Rotifers living in tubes which they had built for themselves. He could not account for this habit because they were not breeding, and he had found quite as many free swimming as tube building, but no eggs or embryos. He had found tubes built by *Rotifer marcrurus*, and also by *Rotifer vulgaris*.

Mr. Bryce said that it was recorded by Gosse that *Furcularia forficula* was sometimes found living in tubes, and he thought there was also a record as to *Rotifer vulgaris* in the "Q.M.C. Journal." He rather inclined to the idea that the case was more an aggregation of odd atoms than one regularly designed and constructed as was seen amongst the Melicertidæ, and that such atoms drawn together by the action of the ciliary organs were caused to adhere from contact with some sort of saliva or secretion. It was very interesting to find the same thing occurring in these specimens from the West Indies.

Mr. Western could not think that the formation of these tubes was merely accidental, though they might, like those of Œcistes, be partly formed of extraneous matters which became attached to them; but the way in which the Rotifer retired into its tube when alarmed and then came out again to feed was, he thought, evidence that the tube was designedly constructed.

Mr. Grenfell noticed that the authors of both papers had made reference to the drying up of Rotifers, but if they were revived it would show that they were not dried up—though what they had seen might have come from eggs. The subject had been recently dealt with in "Natural Science," and there it was shown that they could not be revived.

Mr. Western said he had no doubt at all as to the possibility of drying up Rotifers and then reviving them. He had frequently had them dried upon paper and had revived them under the microscope, and had been able to revive Rotifers after being dried for two years.

Mr. Bryce said the question raised in "Natural Science" had more particularly to do with *Furcularia forficula*, and he could not speak from experience as to that; but as regarded *Philodina Roseola*, he was sure that it could be revived after long periods of drying.

Mr. Hailes said there could be no doubt about the matter because it had been seen over and over again.

The President noticed the statement in "Natural Science," and thought it was certainly too dogmatic, because the facts were very well known to numbers of microscopists who had made the experiments for themselves.

Mr. Ingpen was rather surprised that any question should be raised about this matter, because the experiments made by Mr. Henry Davis many years ago were quite conclusive.

Mr. Bryce said that Mr. Davis read a paper on the subject before the R.M.S., which was published in the "Monthly Microscopical Journal" for 1873. The experiments detailed were commented upon by Dr. Hudson and regarded by him as fully explaining the facts. Mr. Davis found that the apparently dry balls were really moist inside, being protected from complete desiccation by the hardened gelatinous coating. With regard to the Rotifers and their tubes, he thought that those which had become used to living in this way would no doubt seem nervous if turned out of them. He did not mean to imply that they had no purpose in making them, but his contention was that the secretion given off from the lips would naturally cause particles to adhere to one another around the Rotifer, and therefore, though the construction of the tube might not be in the strict sense purely accidental, it was accidental to the process that it should come to be largely formed of extraneous matter.

Mr. King said that these Rotifers did not construct their tubes by drawing matter towards them and working it up for the purpose, but they simply took such material as they found ready, and adapted that to the formation of a dwelling. He had isolated the one which he had described and kept it thoroughly under observation.

The President said the paper had proved to be an interesting one, and had led to discussion which had brought out some useful points. Their thanks were heartily accorded to Mr. King for his communication.

Announcements of meetings, etc., for the ensuing month were then made, and the proceedings terminated with the usual conversazione.

October 7th, 1892.—Conversational Meeting.

The following objects were exhibited :—

Zoothaminium arbuscula	Mr. F. W. Andrew.
Distyla mermis } n. sp. ... ... *Callidina pusilla* }	Mr. D. Bryce.
Pedalion mirum	Mr. W. Burton.
Thunbergia alata, Section	Mr. G. E. Mainland.
Amphiphora elegans	Mr. H. Morland.

October 21st, 1892.—Ordinary Meeting.

E. M. Nelson, Esq., F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club :—Mr. J. L. Luscombe and Mr. Thomas W. Hinds.

The Secretary said he felt sure that every member of the Club would hear with extreme regret the announcement of the death of their esteemed friend and the Editor of their Journal, Mr. H. F. Hailes, which occurred only that morning. His own connection with Mr. Hailes had for many years been a very close one, and he felt the loss to be a peculiarly personal one; but the members of the Club generally to whom Mr. Hailes had so long been known would, he knew, very largely share in that feeling. Of course the Committee at their meeting that evening had taken special notice of this sad event, and had passed a resolution of sympathy, which would be forwarded to the family of their late friend. The resolution was as follows : "The Committee of the Quekett Microscopical Club have heard with deep regret of the death of their esteemed colleague, Mr. Henry F. Hailes, one of the original members, and for many years Foreign Secretary and Editor of its Journal, and they

desire to express their profound sympathy with his family in their bereavement."

The Chairman said that they met that evening under circumstances of great sorrow. Although he had not been brought so much into personal relation with Mr. Hailes as Mr. Karop had, yet he had known him for a great number of years, and could say that in all his business transactions with him in connection with the Journal he had never met with anyone more ready to give his help whenever he went to him for his advice or assistance in any matter connected with the Club, and looking back upon his connection with them, he could not recollect a single meeting when Mr. Hailes was not present. He could only feel with others that a terrible blow had fallen upon the Club.

Mr. J. G. Waller inquired if the resolution which had been agreed to by the Committee could not be adopted by the whole of the meeting? He thought this would be a course which would strongly recommend itself to the members who were present.

The Chairman at once agreed to this suggestion, and having put the resolution to the meeting, declared it to be unanimously carried.

The following donations to the Club were announced:—

"The American Monthly Microscopical Journal"	In Exchange.
"Science Gossip"	" "
"Annals and Magazine of Natural History"	Purchased.
"Journal of the Royal Microscopical Society"	From the Society.
"Report of the Brighton and Sussex Natural History Society"	" " "
"Bulletin of the Minnesota Academy of Natural Sciences"	" " "
"The Essex Naturalist"	From the Editor.
"Proceedings of the Royal Society" ...	From the Society.
"Le Diatomiste"	From the Editor.
"Proceedings of the Croydon Natural History Society"	"
"The British Moss Flora," Part XIV. ...	"
"La Nuova Notarisia"	"

The thanks of the Club were voted to the donors.

Mr. Karop exhibited and described a microscope made by Messrs. Swift almost entirely of aluminium, with the result that the weight was reduced from 7lb. 13oz. in the brass model to 2lb. 10½oz. in the instrument before them. He believed this was an absolute novelty, and would commend itself at least to those persons who were much in the habit of carrying their microscopes about with them. Certain parts, such as rack and pinion, and screws, had necessarily to be made of another metal, and some trouble had been experienced in the matter of soldering and polishing. The price could not at present be stated.

The Chairman congratulated the makers upon their achievement; this was certainly the lightest microscope he had ever handled, and he had rarely seen anything more beautifully finished.

Mr. Morland said he believed a means of soldering aluminium had recently been discovered. It was mentioned in the "English Mechanic;" he thought it was some preparation of chloride of silver which was used. It could also be united by a process of electric welding. It was coming largely into use for soldiers' accoutrements on account of its extreme lightness.

The Secretary said he had received from Mr. Stevens a small sample of Diatomaceous earth from under the market-place at Christchurch, New Zealand, which had been handed to Mr. Morland for examination.

Mr. Morland said the Christchurch deposit contained a quantity of *Surirella contorta* and other forms. It was rather sandy, and therefore not very easy to pick out; but some good specimens could be got with patience.

The Secretary said he had also received a batch of communications from Dr. Arthur Meade Edwards, which he should have been glad to have read if possible, but, unfortunately, having been written with an electric pen or some similar contrivance, the result was so far illegible that it was hopeless to attempt to decipher it.

Mr. C. L. Curties exhibited a small stand carrying a bottle with polished sides, intended for filling with different solutions, for the purpose of obtaining monochromatic light; also two slides of *Rhomboides*, one mounted in quinidine and the other in styrax. For photography there was some advantage in quini-

dine over styrax, but he found that it was difficult to keep. The specimen shown had crystallized after the first month, but when remelted it was quite restored.

Mr. Karop said that what remained of the *Rhomboides* in his slide certainly came out very well.

The Chairman said that quinidine was a substance which seemed to him to have the greatest possibilities; it certainly was the most brilliant resolving medium with which he was acquainted, and he hoped that all who could work at it would do their best to try and find some means of securing its permanence.

Mr. Morland said that if after a time it was found to recrystallize all they had to do was to warm it up again, and it would be all right.

Mr. C. L. Curties pointed out the necessity for not "ringing" slides so mounted, otherwise when warmed the varnish would be likely to run in.

The Chairman exhibited and described a new form of spherometer, made from his own designs, for the purpose of measuring the curvatures of lenses of various sizes.

Mr. Ashe being unable from cold to read his paper "On the Determination of Optical Tube Length," it was read by the Secretary.

The Chairman thought this was a valuable communication giving them an original and very simple formula for getting the equivalent of the tube length, and he would advise every microscopist to write it on the first page of his note-book. It furnished them with a ready means of getting the arithmetical equivalent, and from that they could always ascertain the power of an unknown objective. The only previous way was to find the diameter of a projected image at a great distance—say five feet—by which any small error in the distance would be absorbed; but the manner suggested by the paper was very much more simple, and it had only to be known and appreciated to ensure its being used every day.

Mr. Western read his "Notes on Rotifers," illustrating the subject by drawings on the black board.

Mr. Bryce congratulated Mr. Western on having been able to clear up some doubtful points, and thought it was a great help to those who took an interest in such matters to get them so nicely described.

The thanks of the Club were cordially voted to those gentlemen who had communicated papers, etc., to the meeting.

The Secretary said that in consequence of the death of their Editor the Committee had been placed in some difficulty with regard to the Journal, but he was glad to be able to announce that Mr. Nelson had very kindly come to their assistance by undertaking the duties of Editor *pro tem.*

Mr. Nelson said he should be very glad to render what service he could in the matter; but they might be sure he would not have undertaken the work had it not been for the assurance that he should have the kind assistance of Mr. Karop in connection with it.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited :—

Cheap German Lens by Leitz	Mr. A. Ashe.
Fredericella sultana	Mr. F. W. Andrew.
Stem of Juniper, Trans. Sec.	Mr. W. J. Brown.
Euchlanis diletata...	Mr. W. Burton.
Nav. Rhomboides, in Quinidine ... ,, ,, in Styrax ...	Mr. C. Lees Curties.
Chætoceros, sp., in very remarkable and hitherto undescribed sheaths, apparently membranous ...	Mr. J. G. Grenfell.
Brachionus brevispinus, Ehr., new to England	Mr. C. Rousselet.
Crystals of Cinchonidine, Mount 20 years old	Mr. Geo. J. Smith.

NOVEMBER 4TH, 1892.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Macrothrix laticornis ... ... *Euchlanis triqueta*	Mr. W. Burton.
Hemiaulus alatus	Mr. H. Morland.
Funaria hygrometrica, with pseudoscopic binocular	Mr. Alpheus Smith.

NOVEMBER 18TH, 1892.—ORDINARY MEETING.

E. M. NELSON, Esq., F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—The Rev. J. C. Pratt, Mr. Leonard Sandall, Mr. A. S. Ussher, and Mr. Frank Orfeur.

The following donations to the Club were announced, and the thanks of the meeting were given to the donors:—

"Proceedings of the Geologists' Association"	From the Association.
"The Essex Naturalist"...	,, Editor.
"The Botanical Gazette"	,, Publisher.
"The Microscope"	,, ,,
"The American Monthly Microscopical Journal"	,, ,,
"Proceedings of the Belgian Microscopical Society"	,, Society.
"Proceedings of the Brighton and Sussex Natural History Society"	,, ,,
"Journal of the Royal Microscopical Society"	,, ,,
"Science Gossip"	,, Editor.
"Annals of Natural History"	Purchased.
"Practical Photo-Micrography," Bousfield	From the Author.

The Chairman called attention to a new book by Mr. Bousfield, "On Photo-Micrography." He had not yet had the opportunity of reading it, but, so far as he could see from glancing through, it seemed to be a work well worthy of the attention of all who were interested in the subject.

Mr. Karop caused considerable amusement by reading some extracts from a newspaper report of the recent *Soireé* of the Ealing Microscopical Society, taken from the "Middlesex County Times," of November 5th, which afforded a striking illustration of the knowledge possessed by the average newspaper reporter, and his methods of expressing it where scientific matters were concerned. According to this report,

amongst many remarkable things shown by Members of the Quekett Club, they were informed that "Mr. E. Bartlett caused his microscope to disclose that which lay concealed in the inside of heather," "Mr. T. Simpson enlarged the vision of the human skin," and "Mr. F. A. Parsons illuminated the composition of bog-moss." The climax was, however, reached by the statement that "in addition to illustrations under the microscope, Mr. C. Jones brought an *achromatic spectroscope*," this being what Mrs. Malaprop would call "a nice derangement of epitaphs."

Mr. Watson exhibited and described a new form of the "Edinburgh Student's Microscope," in which this well-known instrument was mounted upon a tripod base.

Mr. Karop thought that in the form now shown this was certainly a very nice microscope, but he could hardly see why it should be cut away so much at the back; possibly this did not actually affect its strength, but it had the appearance of weakening it.

The Chairman said this microscope had been some time in his possession, having been sent to him specially that he might examine the fine adjustment, which had been somewhat severely criticized at a meeting of the Royal Microscopical Society some time ago. His opinion was asked about it at the time, but he had not then any opportunity of examining it, but the adverse remarks were then made on the assumption that the fine adjustment was made on the Zentmayer plan, which it seemed had always gone wrong after a short time in ordinary use. It appeared, however, on examination that this differed very materially from Zentmayer's, inasmuch as the groves were thoroughly sprung, so that if it began to show signs of wear it could always be tightened up again by turning the screws. There seemed to be no difference in construction between this and the similar pattern of Messrs. Swift, except that the lever in one was placed vertically, and in the other it was at right angles. He considered this to be a very nice instrument with its present stand; the horse-shoe foot was always very heavy, and for all that it was easily thrown over, so that both for lightness and steadiness he greatly preferred the tripod.

The Chairman exhibited a simple apparatus for projecting the image of any large object under low power upon paper

placed below it, so as to enable anyone to draw it. The structure of the arrangement and the method of using were described. In reply to a question it was explained that the image obtained was inverted and transposed, as seen in the microscope, and not as was the case with drawings made with the camera lucida, which corrects the inversion, but leaves the transposition.

Mr. Western read some interesting extracts from a letter received from Surgeon Gunson Thorpe, R.N., whose ship at the date of writing was lying in the Yangtze-Kiang river, on the China Station. The writer mentioned the extreme richness of the fresh water pools of the district as regarded Rotifers, and promised in a future communication to send detailed descriptions of some new and remarkable forms of Melicerta, Trochosphera, and Lacimilaria which he had recently met with.

Mr. Scourfield read his paper "On the Entomostraca of Wanstead Park."

The Chairman was sure all present would agree with him that Mr. Scourfield had given them a most excellent paper, in which the subject had been treated in a most masterly way. The publication in the Journal of the curves, which had been drawn in illustration of the abundance of various species at different times in the year, would add greatly to the interest of the paper when printed.

Mr. Karop was very glad that Mr. Scourfield had come forward with this paper on a subject which had been so little touched upon. When he read his last paper the hope was expressed that he would follow it up by others, as it appeared that they had never before had a paper read at the Club on the Entomostraca.

Mr. T. F. Smith read a paper "On Photo-Micrography, with Iso-Chromatic Plates," the subject being illustrated by a number of photographs, which it was explained had been taken by Messrs. Swift's latest series of objectives made with Jena glass. In the case of the $\frac{1}{2}$in. no eye-piece had been used.

The Chairman thought some of these photographs were very beautiful; so good, indeed, that they bore examination with a lens.

Mr. Karop said he had been also struck with the excellence of these photographs. He did not remember to have seen any

better of histological subjects. One of Spermatic tubes, and another of Kidney were well worth special notice. To produce good—that was useful—photographs of anatomical structure it was, of course, necessary to select good preparations in which the details wanted were really well shown. This could, as a rule, only be done by persons who understood what the structure was, because these things were not like diatoms—all alike—except as to clean or unbroken condition.

Mr. C. Haughton Gill thought Mr. Smith had rather misunderstood his remarks, from the quotations made in his paper as to the use of the light filter, because if he really said that owing to its use he could with a cheap ordinary achromatic make as good photographs as could be obtained by expensive apochromatic objectives, that was not the meaning he had intended to convey. What he meant was that because a person did not possess these expensive lenses he need not give up the idea of making good photographs, since by the use of the light filter they could photograph anything, which the lens they had would show; but, of course, things which were beyond the resolving power of a lens could no more be photographed than they could be seen by it. Given the use of the light filter, they could photograph all they could see. Two very good lenses which he had used were one of Beck's ordinary $\frac{4}{10}$in., and one of Reichert's 35s. objectives, which he found to be a very good achromatic of its kind. He did not quite follow Mr. Smith's remarks as to the iso-chromatic plates bringing the chemical and visual foci together again after they had been separated by the lens. That he got a sharp image in the focus of the visual rays there could be no doubt, but the reason of this was that these plates were sensitive to the rays, which were active in producing the visual focus, and, therefore, it was not necessary to work with a focus nearer the violet end of the spectrum. The plate did not cause the two foci to become coincident, but only enabled a sharp picture to be taken by the visual rays.

Mr. Smith said he was not at the meeting when Mr. Gill read his paper, but had taken his idea from a report which he saw in the "English Mechanic."

The Chairman thought they ought to be extremely thankful that this cheap series of objectives was being added to and

improved every day. When they could get a lens for 20s. or 30s., which, for many purposes, would rival the best apochromatics, it was a very great advantage, and every month they seemed to be getting more perfect lenses, in which the spectrum was marvellously corrected. He could not speak offhand as to the merits of the iso-chromatic plates, but the results shown that evening were worth looking at. Mr. Gill had, no doubt, perfectly explained their action, which could not be due to their bringing the chemical and visible foci together, but was due to the image-forming rays being the active rays, where these plates were employed. As regarded the screen, it would, of course, be more convenient if it could be made of solids rather than liquids, and he had met with some success by combining different tints of coloured gelatin obtained from "Tom Smith's crackers" with coloured glass. The next thing he hoped to do was to get a screen made all of glass. The Germans had criticized a term which had come into use, he thought, at his own suggestion—semi-apochromatic—they objected to it on the ground that there could be no such thing; a glass must be either apochromatic or achromatic, and could not be half and half. When they took what was considered to be a first-rate achromatic lens six years ago and compared it with the best apochromatics there was an enormous difference between them; but there was if anything less difference between the new series and the apochromatics than there was between the new series and the old achromatics, so that there was ample justification for the new term.

The thanks of the meeting were voted to Mr. Smith for his paper.

Mr. Karop said they had received a paper from Mr. T. B. Rosseter, describing two new Cysticerci, of which well-drawn figures were also sent in illustration. Mr. Rosseter had been giving a good deal of attention lately to this subject, and it would be very useful to have his observations put on record. The time was, however, too far advanced to read it in extenso that evening, but it would be taken as read, and would appear in the Journal in usual course.

The thanks of the Club were voted to Mr. Rosseter for his communication.

Announcements of meetings, etc., for the ensuing month

were then made, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited :—

Conochilus volvox	Mr. F. W. Andrew.
Lucernariæ, *Haliclystus octoradiatus* ...	Mr. E. T. Browne.
Fossil Coniferous Wood, *Arancarioxylon Withami*, and Calamite, both with Insect Larvæ Borings... ...	Mr. G. J. Smith.

December 2nd, 1892.—Conversational Meeting.

The following objects were exhibited :—

Medusa, *Corymorpha nutans*	Mr. E. T. Browne.
Floscularia ornata and *Melicerta ringens*...	Mr. W. Burton.
Auliscus spinosus	Mr. H. Morland.
Shells of *Astracoda*, from Samarang, Java	Mr. B. W. Priest.
Asplanchna periodonta and *Pedalion mirum* (preserved)	Mr. C. Rousselet.

December 16th, 1892.—Ordinary Meeting.

Dr. W. H. Dallinger, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following were balloted for and duly elected members of the Club :—Mr. W. Cheshire, Stirling Villa, Sutton; Mr. G. Wynne, 28, Nelson Square, S.E.; Mr. C. C. Watts, Kensworth, Dunstable; Mr. R. Smith, 152, Brixton Road, Macclesfield.

The following additions to the library were announced and duly acknowledged :—

"Bulletin de la Société Belge de Microscopie."

"Trans. Hertfordshire Natural History Society."

"Science Gossip."

"Annals Natural History."

"Botanical Gazette."

"Quarterly Journal Microscopical Society."

"Manual of Photo-Micrography," E. C. Bousfield, L.R.C.P., 2nd edition.

Professor W. C. Williamson, F.R.S., gave an address "On the Mineralization of the Minute Tissues of Animals and Plants."

Dr. Dallinger having to retire before the termination of Professor Williamson's address, the Chair was taken by Professor Lowne, F.R.C.S., Vice-President.

Professor Lowne said—I have listened to the lecture just concluded with the deepest interest, and I do not think we have ever heard anything more interesting in this room. Though the subject is out of my own line, it is of such importance that I am surprised, in a society like this, it is not more taken up. I suppose the main reason is because it is difficult to prepare sections of these mineralized tissues. It would be very convenient if it were possible to invent a microtome for the purpose, although, of course, this is out of the question. I am sure you will all desire a very hearty vote of thanks to Professor Williamson for having come here and given us such a valuable discourse.

The vote of thanks was carried with acclamation.

A very extensive series of preparations were exhibited by Professor Williamson in illustration of his lecture.

The Secretary said—We have decided, at the committee meeting this evening, to alter the date of the publication of the Journal from January and July to March and October. By the former arrangement the matter was divided into two unequal parts on account of the vacation, but now we shall have two equal ones of five months and the March number will take in the President's address and the business of annual meeting generally. It will possess the further convenience of having the list of Excursions before they begin, whereas formerly they were mostly over before the July number appeared. The committee have also decided to raise the price of it to non-members to 3s. 6d. per number, as at present the cost price, with the charges and commission for sale and publication, is such that we are positively out of pocket by it.

The usual announcement of meetings for the ensuing month was then made, and the proceedings terminated.

The following objects were exhibited:—

Anuræa curvicornis ... ... Mr. W. Andrew.
Lophopus crystallina ... ... Mr. W. Burton.

Palatal Tooth of *Ctenodus elegans* from Northumberland Coal Shale, compared with teeth of *Acanthurus*, an existing species	Mr. H. E. Freeman.

JANUARY 6TH, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Amœba proteus	Mr. W. Burton.
Foraminifer, *Rotalia pulchella*, from Samarang, Java	Mr. B. W. Priest.

JANUARY 20TH, 1893.—ORDINARY MEETING.

A. D. MICHAEL, Esq., F.L.S., Pres. R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. C. Ashmore Baker, and Mr. G. P. Dineen.

The list of candidates for admission was read and suspended until the next meeting.

The following additions to the library were announced :—

"La Nuova Notarisia," "Trans. Canadian Institute," "Trans. Eastbourne Nat. Hist. Society," "Jour. N. Y. Micros. Soc.," "Ann. and Mag. Nat. Hist.," "Proceedings Royal Society," "Science Gossip," "The Microscope," etc., by Dr. H. Van Heurck, trans. by W. E. Baxter, F.R.M.S., and presented by him to the Club.

A vote of thanks was passed to Mr. Baxter for his donation.

A list of the nominations made by the Committee was read as follows :—As President, Mr E. M. Nelson, F.R.M.S. ; Vice-Presidents, Dr. W. H. Dallinger, F.R.S., Prof. Lowne, F.R.C.S., Mr. Michael, P.R.M.S., and Prof. C. Stewart, P.L.S. ; as Foreign Secretary, Mr. C. Rousselet, F.R.M.S. The other officers as be-

fore. Nominations for five vacancies on the Committee were made by the members and Auditors appointed.

Mr. D. Bryce read a paper on "Two New Rotifers: *Callidina pusilla* and *C. cornigera*."

The thanks of the Club were voted to Mr. Bryce for his interesting paper.

Mr. Rousselet read a paper "On a Method of Preserving Various Forms of Pond Life."

Mr. Western said that Mr. Rousselet had given him opportunities of watching the processes he had described, which he considered very valuable for the purpose, as the members could judge from the specimens Mr. Rousselet was showing that evening. They certainly wanted the charm of life, but it was now possible to keep specimens of Rotifers and such like, which were really valuable for purposes of reference. In some cases the structure was more visible than in the living animal. He had made a few attempts with tolerable success, and he thought anyone with a little experience would not fail to get good results.

The Chairman considered Mr. Rousselet's extremely useful and interesting paper supplied a great want—a suitable method of preserving Rotifers, etc., in a way resembling what they were in life. While hearing his communication, it struck him how very useful it would be for preserving a great many other structures, such as the Polyzoa and other forms of lower life. He was convinced that for creatures bearing tentacles the process of narcotizing as slowly as they possibly could and then fixing was practically the only process which would give satisfactory results They all knew how absolutely necessary it was to adopt some fixing-agent immediately after death; what that agent should be depended upon the creature with which they were dealing. Mr. Rousselet's fluid gave very satisfactory results in the case of Rotifers. He moved that the thanks of the members be given Mr. Rousselet for his paper.

The Secretary read a paper by Dr. Edwards, of New Jersey, U.S.A., "On Some Diatomaceous Earth from Guatemala."

Mr. Nelson gave some instances of the enormous distances that volcanic material was projected.

Mr. Newton said it was very interesting to find probable marine forms of diatoms in fresh-water deposits, or fresh-water

forms in marine deposits. It might be that the diatoms lived now in the fresh water and now in the sea. He understood that the diatoms were found attached to pieces of pumice as if grown there; that would show that they were subsequent to the deposit, though the diatoms might have come a long distance, and lived since the age of the deposit.

The Secretary, referring to the paper, said the *Coconeis Mexicana* was attached to the deposit. As to the mixing of deposits, it was easy to see that fresh-water species might be carried into marine deposits, but it was more difficult to see how marine forms should be carried up a river, as they would be rapidly killed by fresh water.

The Chairman said that his impression rather was that the killing of fresh-water forms in the sea, or marine forms in fresh water, was not so invariably the case as might be supposed. No doubt some forms were extremely sensitive. There were certain star-fish which could hardly be obtained perfect, except by dropping them into fresh water out of the net, and so give the creature no time to destroy itself. On the other hand, he thought there were a great many forms that could be transferred from sea water to fresh water by adding more and more fresh water as the creature got to bear the change. And as minute fresh-water forms got to the mouths of rivers, they got more tidal water, and so passed through a process of acclimatization to a greater extent than people were prepared to give credit for. He thought it quite possible that many forms had, by such a slow process of transference, got changed from salt water to fresh or fresh water to salt, as the case might be. He moved that the thanks of the meeting be presented to Dr. Edwards for his communication.

The announcements for the ensuing month having been made, the meeting closed with the usual conversazione.

The following objects were exhibited:—

Nitzschia, sp., living	Mr. H. C. Gill.
Mounted Rotifers...	Mr. C. Rousselet.
Radiolaria, from Antarctic Ocean, "*Challenger*"	Mr. B. W. Priest.

FEBRUARY 3RD, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Agalophenia tubulifera (Plumularidæ)...	Mr. E. T. Browne.
Melicerta ringens	Mr. W. Burton.
Dimeregramma Novæ-Cæsarea, from Artesian Well, 406 ft. deep, New Jersey, U.S.A....	Mr. H. Morland.
Spicules of *Alcyonium*, Ceylon	Mr. B. W. Priest.

FEBRUARY 17TH, 1893.—ANNUAL MEETING.

The Rev. W. H. DALLINGER, L.L.D., F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Surgeon V. Gunson Thorpe, R.N., Mr. John Hunt, Mr. Leonard Grocock, Mr. F. J. M. Palmer, Mr. T. I. Pennel, and Mr. W. Ward.

The following were also elected Honorary Members of the Club :—Dr. R. Braithwaite, Dr. M. C. Cooke, Mr. Arthur E. Durham, Prof. T. H. Huxley, Mr. T. Charters White, and Prof. Williamson.

The following donations to the Club were announced :—

"Journal of the Royal Microscopical Society"	From the Society.
"The Essex Naturalist"	„ Editor.
"Science Gossip"	„ Publisher.
"Proceedings of the Royal Society" ...	„ Society.
"Botanical Gazette"	In Exchange.
"Proceedings of the Belgian Microscopical Society"	"
"Proceedings of the Scientific Society of Chili"	"
"Annals of Natural History"	Purchased.

The thanks of the Club were voted to the donors.

The President having appointed Messrs. J. M. Allen and W.

Burton to act as scrutineers of votes for the election of officers and of five members to fill vacancies on the Committee, the ballot was proceeded with.

The Secretary then read the 27th Annual Report of the Committee.

The Treasurer read his statement of accounts and the balance sheet (duly audited) for the year 1892.

It was moved by Mr. Stocks, seconded by Mr. C. Haughton Gill, and unanimously resolved, "That the Report and Balance Sheet, now read, be received and adopted, and that they be printed and circulated in the usual way."

The President then read his Annual Address, which was listened to with great attention and very heartily applauded.

Prof. B. T. Lowne said he rose to move a vote of thanks to their worthy President for the very interesting address which they had just heard, and also for the able manner in which he had carried out the duties of President. All who had been associated with him would agree that he had done them a very great service in holding the office for a period of four years, although it came to him as a startling fact that four years had actually slipped away since the time when he himself had occupied the position and yielded it up to Dr. Dallinger. They would, however, not only thank him for those services so ably rendered, but on that occasion would specially return their thanks for the very excellent address of that evening, one so highly suggestive and embracing so many topics of extreme interest, even though some of them might appear to be in some degree controversial. They would, no doubt, feel deeply grateful for those very interesting observations which he had made on the subject of the so-called artificial amœboid movements, for although he no more thought that there was such a thing as artificial protoplasm, than the President did, it was yet possible that through them they might get some light upon matters bearing upon such topics, though that anyone could seriously suppose that there was any identity between such movements and the marvellous phenomena of living protoplasm was something to him altogether inexplicable. Then the allusions in the latter portion of the paper as to nitrification opened up a subject so wide and so difficult to follow and to analyse that they must all feel they would like to have the

opportunity of seeing it in print. To him, at least, the statement that the presence of nitrogen in the soil was due to the oxidation of nitric acid seemed to be a very serious matter.

Mr. A. D. Michael had very great pleasure in seconding the proposal, and in asking all who were present to return a hearty vote of thanks, not only for the paper, but also for the long and efficient service which Dr. Dallinger had rendered to the Club as its President.

The motion was then put to the meeting by Prof. Lowne, and carried by acclamation.

The scrutineers having handed in their report, the following was declared to be the result of the election :—

President	E. M. Nelson, F.R.M.S.
Four Vice-Presidents	Rev. W. H. Dallinger, LL.D., F.R.S. B. T. Lowne, F.R.C.S., F.L.S. A. D. Michael, Pres. R.M.S. Prof. Stewart, Pres. L.S.
Treasurer	J. J. Vezey, F.R.M.S.
Secretary	G. C. Karop, M.R.C.S., F.R.M.S.
Foreign Secretary .	C. Rousselet, F.R.M.S.
Reporter	R. T. Lewis, F.R.M.S.
Librarian	Alpheus Smith.
Curator	C. Emery.
Five Members of Committee.	F. A. Parsons. F. W. Hembry, F.R.M.S. E. T. Browne, F.R.M.S. G. Western, F.R.M.S. E. T. Newton, F.G.S.

Dr. Dallinger said that it now only remained for him to thank the members of the Club for the kind and cordial way in which they had passed the resolution of thanks. For his own part, he could say that it had given him great pleasure to occupy the position to which they elected him four years ago. He entered upon it then with very much interest as the successor of Dr. Lowne, and he now seceded from it by again thanking them for their kindness in the past and heartily welcoming Mr. Nelson as his successor.

Mr. E. M. Nelson, who was very cordially received on taking

the chair, said that he thanked the members of the Club very much for the honour done to him by his election as their President, the highest honour they were able to confer. He felt it would be rather trying to have to occupy the chair in succession to their last three Presidents, but it would be his best endeavour to walk worthily in their footsteps. His first act would be to present to the Club the cabinet of slides upon the table before them in memory of their late member and editor, Mr. H. F. Hailes, who had, as many of them knew, devoted his attention very largely to Foraminifera, and the collection before them was his own work. There were also amongst the slides some hard sections which had been collected by him. He hoped the possession of this collection would prove of great educational value to the members of the Club.

A special vote of thanks having been accorded to Mr. Nelson for his valuable gift,

Mr. C. Haughton Gill moved a vote of thanks to the auditors and scrutineers for the work which they had so kindly done.

This motion having been duly seconded. was put to the meeting by the President, and carried unanimously.

Mr. Buffham said he had great pleasure in proposing that the best thanks of the members be given to the officers and committee of the Club for their services during the past year. He was sure such a motion as that needed no recommendation from him, because it must be obvious to all that there was a great deal of work to be done, and that it was done very efficiently was equally well known, and whilst the committee and the officers did the work, the majority of the members only looked on and enjoyed the benefit of it. As their new President was included in the number of those referred to, and could not, therefore, put the motion himself, it was a great pleasure to him (the speaker) to put it to the meeting without further formality. Carried *nem. dis.*

Mr. Karop said it fell to him to return thanks on behalf of the officers of the Club, and he could only say that they were extremely glad to be able to do anything to promote its well-being. He thought they were rather to be regarded as fixtures; at least, he believed he was the junior amongst them, and he had held the same office for ten years, and as they had done him and his colleagues the honour of re-

election, he could only assure them that they would continue to do their best for the welfare of all concerned.

The proceedings then terminated with the usual conversazione, at which the following objects were exhibited:—

Synchæta mordax...	Mr. F. W. Andrew.
Foraminifera *Lagena melo* with external neck, Porto Seguro	Mr. H. E. Freeman.
Pure cultivation of *Amphora*, var. ...	Mr. C. H. Gill.
Floscularia Edentata, showing *trophi* ...	Mr. F. A. Parsons.
Floscularia Edentata, *Notops minor* ...	Mr. C. Rousselet.

TWENTY-SEVENTH ANNUAL REPORT.

Once more your Committee is in the position to place before you a satisfactory account of the Club's affairs.

Its general efficiency is well maintained, and, in some respects at least, it has shown an advance on previous years.

Up to the end of the past year fifty-two new members were elected, a total slightly larger than in the preceding one, which was the highest for more than a decade. On the other hand the number of resignations and withdrawals is somewhat increased. Death has also removed ten from our list, amongst whom particularly we have to deplore Mr. W. W. Reeves, and our esteemed Editor and Foreign Secretary, Mr. H. F. Hailes. Both were original members, and both had taken an active part in the Club from its foundation. A memoir of Mr. Reeves, from the pen of Mr. Ward, was given in the Journal for July, and one of Mr. Hailes, by his old friend and our Curator, Mr. Emery, will appear in the forthcoming number. Up to December 31st last the total number on the books was 368.

The meetings have been extremely well attended, and a manifest interest taken in the proceedings. The list of papers given below shows no falling off in quantity, while the quality of many was of great excellence.

January.—"On the Macrotrachelous Callidinæ," by Mr. D. Bryce. "Note on a species of Ixodes found on a S. African lizard," by Mr. R. T. Lewis.

February.—"On a new marine Chantransia," by Mr. T. H. Buffham. "On the conjugation of a diatom, *Orthoneis binotata*, Grun.," *Idem*. "On a simple method of finding the refractive index of mounting media," by Mr. E. M. Nelson.

May.—"On some new records of British Cladocera," by Mr. D. J. Scourfield. "On Binoculars," by Mr. E. M. Nelson.

June.—"On *Monstera deliciosa*," by Mr. H. W. King.

September.—"On a new species of Adineta found in moss," by Mr. D. Bryce. "Observations on pond-life from the W. Indies," by Mr. W. H. King.

October.—"On the measurement of optical tube-length," by Mr. A. Ashe. "Notes on Rotifers," by Mr. G. Western.

November.—"On the Entomostraca of Wanstead Park," by Mr. Scourfield. "On two new Cysticerci found in *Cyclops agilis*," by Mr. T. B. Rosseter.

December.—"On the mineralization of the minute tissues of animals and plants," by Prof. W. C. Williamson, F.R.S.

Descriptions of new instruments and various notes on many subjects were also brought before the meetings, a record of which will be found in the proceedings. It is an encouraging feature to note some new names amongst the contributors, an example the Committee trust will be extensively followed, as they are convinced that considerable talent is latent in the Club.

Under the able direction of our energetic Treasurer, the finances, as will be seen from the balance-sheet, are in a very satisfactory condition. The amount from subscriptions is larger than usual, and the proceeds from the sale of the Journal much beyond the average. The latter item is due to a thorough revision of the stock in the hands of our publishers, which had not been undertaken for some time.

With regard to the Journal itself, the lamented death of our Editor before alluded to, who had successfully conducted it for many years, might have caused your Committee both anxiety and difficulty, but, as the majority of members are aware, Mr. Nelson most kindly undertook the by no means light duties of the editorship, and they are assured that in his hands it will be carried on with ability and success, and that its present reputation will be thoroughly maintained. It has, however, been deemed advisable to alter the dates of publication from January and July to March and October, which will permit a more even distribution of the subject matter than the former arrangement and be more convenient in several ways. It has also been found necessary to increase its price to non-members to 3s. 6d. per number.

A Special Exhibition was held in May at Freemasons'

Tavern, the expenses as before being defrayed by subscription. This meeting proved eminently successful, and the pleasure of all attending was greatly enhanced by the performance of an excellent amateur orchestra, for which the Committee were indebted to the good offices of Mr. Jno. Reed, and the kindness, more especially, of Dr. Dundas Grant. A special vote of thanks was transmitted to these gentlemen.

It is not proposed to hold a similar meeting this year, as your Committee is of the opinion that if too frequently repeated the interest is liable to flag, and thus, the chief end of these gatherings defeated.

The following is a list of the books acquired by donation, purchase, or exchange, and added to the Library during the year :—

"Bousfield's Guide to Photo-Micrography"	Presented by— The Author.
"The Microscope," by Van Heurck. English Edition, translated by W. E. Baxter	Mr. W. E. Baxter.
"Elenchus Zoophytorum" by P. S. Pallus....	Mr. Scherron.
"British Moss Flora." Part IV.	Dr. Braithwaite.
"Smithsonian Report," 1889	U.S. Government.
"Methods used in preparation of Tissues" ...	Mr. J. W. Squire.
"Journal of the Royal Microscopical Society"	Presented.
"Proceedings of the Royal Society" ...	"
"Hardwickes Science Gossip"	"
"American Monthly Microscopical Journal"	In Exchange.
"American Botanical Gazette"	"
"The Microscope"	"
"La Nuova Notarisia"	"
"Le Diatomiste"	"
"International Journal of Microscopy" ...	"
"Proceedings of the Geological Association"	"
"Essex Naturalist"...	"
Buckler's "Larvæ of British Butterflies and Moths." Vol. iv.	Ray Society Subscription.
"*Challenger* Zoological Reports." Vol. xxxii.	Purchased.
Prof. Lowne's "Anatomy, etc., of the Blow Fly." Part III.	"

"Quarterly Journal of Microscopical Science"	Purchased.
"Annals and Magazine of Natural History"	,,
"Grevillea"	,,

Transactions and Proceedings of various Societies.

The Cabinet has received but few additions, a list of which is below, from the members at large. A very representative and select collection of Foraminifera made by the late Mr. Hailes, who devoted considerable attention to the study of these forms, has been most generously purchased by Mr. Nelson for presentation to the Club, to be kept as a memorial of our lamented friend. The number of preparations is upwards of eleven hundred, and included with them is an extensive assortment of material, portions of which will be given to any member working at the subject on written application to the Committee. The sincere and hearty thanks of the Club are due to Mr. Nelson for this gift, and the Committee hereby desire to place on record their sense of obligation to him in the name of all the members. The revision of the whole Cabinet by a small sub-committee, as promised in the last Report, is in hand, but it is necessarily a very slow process, and no date can be assigned for its completion at present.

List of Slides presented during the past year :—

Mr. R. T. Lewis	1
Dr. W. J. Gray	10 Selected Diatoms.

The Excursions of the past season were fairly attended and reasonably successful in result. At the Whitstable gathering Mr. Seibert Saunders, as usual, lent his valuable services, but the number was rather smaller than could be desired and the weather far from pleasant. The ordinary localities near London are now perhaps almost worked out, and the difficulty of finding new and moderately accessible places, yielding the necessary material, must tax the abilities of the Excursions Sub-Committee. Under the skilful direction of Mr. Parsons, however, a series is arranged which should meet the requirements of both micro-zoologists and botanists.

Your Committee desire to thank the officers for their several services to the Club.

In reviewing the proceedings of the year your Committee is

of opinion that the high position taken by the Club among amateur societies has been fully upheld. A reputation of the kind is not easy to make and perhaps even harder to retain, but with earnest workers the very knowledge of this is an incitement to further effort, and your Committee looks forward with perfect confidence to the continued prosperity of the Quekett Microscopical Club.

QUEKETT MICROSCOPICAL CLUB.

Treasurer's Statement of Accounts for the Year ending 31st December, 1892.

Dr.

	£	s.	d.
To Balance from 1891	124	18	10
,, Subscriptions received in 1892	205	0	0
,, One Compounding Fee	10	0	0
,, Dividends on Investment	3	19	0
,, Sale of Journals and Extra Copies	58	10	5
	£402	8	3

Cr.

	£	s.	d.
By Rent of Rooms and Bookcases (five quarters)	68	5	0
,, Expenses of Journal	100	6	1
,, Postage	8	5	11
,, Printing and Stationery	7	0	2
,, Attendance	5	15	0
,, Petty Expenses	2	0	6
,, Property Purchased	8	17	6
,, Balance at Bank	201	18	1
	£402	8	3

Money invested in £2 15s. Per Cent. Consols, £143 13s. 9d.

J. J. VEZEY,
Hon. Treasurer.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify the same to be correct.

DAVID BRYCE,
W. INGRAM CHAPMAN, } Auditors.

February 3rd, 1893.

Q.M.C. EXCURSIONS, 1892.

March 26th.

List of Objects Found on the Excursion to Hadley Wood, by Messrs. Burton and Parsons.

PROTOZOA.
- *Actinosphærium Eichhornii.*
- *Dinobryon sertularia.*
- *Peridinium tabulatum.*

VERMES. Rotifera.
- *Anuræa aculeata.*
- *Asplanchna priodonta.*
- *Brachionus angularis.*
- *Brachionus pala.*
- *Euchlanis lyra.*
- *Hydatina senta.*
- *Polyarthra platyptera.*
- *Synchæta*, sp., same as found last year.
- ,, *tremula.*
- *Triarthra longiseta.*

Attendance: Twelve members of the Club, two members of other Societies, and two visitors. Total, 16.

April 9th.

Objects Found on the Excursion to Snaresbrook, by Messrs. Burton, Oxley, Parsons, Rousselet, and Scourfield.

CRYPTOGAMIA.

ALGÆ. Desmidiaceæ.
- *Closterium lunula.*
- ,, *setaceum.*
- *Cosmarium margaritiferum.*
- *Docidium baculum.*
- *Euastrum didelta.*
- ,, *elegans.*
- ,, *oblongum.*
- *Micrasterias rotata.*

PROTOZOA.
- *Actinophrys sol.*
- *Actinosphærium Eichhornii.*
- *Dinobryon sertularia.*
- *Halteria grandinella.*
- *Paramecium aurelia.*
- *Phalansterium digitatum.*
- *Protospongia pedicellata.*
- *Stentor niger.*
- ,, *polymorphus.*
- *Trachelius ovum.*

VERMES. Rotifera.
- *Anuræa aculeata.*
- ,, *serrulata.*

Brachionus pala.
,, *urceolaris.*
Cœlopus brachyurus.
Conochilus volvox.
Copeus caudatus.
,, *pachyurus.*
Dinocharis pocillum.
Euchlanis triquetra.
Floscularia cornuta.
,, *ornata.*
Furcularia cæca.
Limnias ceratophylli.
Mastigocerca carinata.
Melicerta conifera.
,, *ringens.*
Notommata aurita.
Notops brachionus.
,, *hyptopus.*
Œcistes umbella.
Philodina aculeata.
,, *roseola.*
Polyarthra platyptera.
Proales parasita.
Rotifer macrurus.
Stephanoceros Eichhornii.
Synchæta baltica.
,, *pectinata.*
,, *tremula.*

CRUSTACEA. Entomostraca.

Acroperus harpæ.
Alona guttata.
Alonella nana.
Canthocamptus minutus.
Chydorus sphæricus.
Cyclops bicuspidatus.
,, *Scourfieldi*, var. The same as described by Professor Brady.
,, *serrulatus.*
,, *tenuicornis.*
,, *viridis.*
Cypridopsis vidua.
Cypris fuscata.
Daphnia cucullata.
Diaptomus castor.
,, *gracilis.*
Simocephalus vetulus.

Attendance: Twenty-one members of the Club, six members of other Societies, and two visitors. Total, 29.

April 30th.

Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London, by Messrs. Burton, Parsons, Scourfield, and Percy Thompson.

PROTOZOA.

Carchesium polypinum.
Cothurnia imberbis.
Epistylis flavicans.
,, *plicatilis.*
Opercularia nutans.
Phacus longicaudus.
Platycola longicollis.
Pyxicola affinis.
Stentor polymorphus.
Trachelius ovum.

CŒLENTERATA. HYDROZOA.

Polyp. of *Limnocodium Sowerbii.*

VERMES. ROTIFERA.

Actinurus neptunius.
Anuræa aculeata.
,, *brevispina.*
,, *cochlearis.*
Asplanchna priodonta.
Brachionus Bakeri.
,, *pala.*
,, ,, var. *amphiceros.*
,, *urceolaris.*
Colurus leptus.
Euchlanis deflexa.
Floscularia campanulata.
,, *cornuta.*
,, *longicaudata.*
,, *ornata.*
Limnias ceratophylli.
,, *cornuella.*
,, sp., with short ventral antennæ, and seven dorsal denticles below corona; tube annulate, grey-brown.
Melicerta ringens.
Œcistes crystallinus.
Philodina megalotrocha.
Polyarthra platyptera.
Rotifer macrurus.
Stephanoceros Eichhornii.
Synchæta pectinata.

CRUSTACEA. ENTOMOSTRACA.

Acroperus harpæ.
Bosmina longirostris.
Candona lactea.
Canthocamptus minutus.
Ceriodaphnia quadrangula.
Chydorus globosus.
,, *sphæricus.*
Cyclops Scourfieldi.
,, *serrulatus.*
,, *tenuicornis.*
,, *vicinus.*
,, *viridis.*
Cypria ophthalmica.
,, *serena.*
Diaptomus gracilis.
Erpetocypris reptans.
Ilyocryptus sordidus.
Ilyocypris gibba.
Leydigia acanthocercoides.
Simocephalus vetulus.

ARACHNIDA. ARCTISCONIDÆ.

Macrobiotus Hufelandii.

MOLLUSCOIDA. POLYZOA.

Fredericella sultana.
Paludicella Ehrenbergii.

Attendance: Twenty-eight members of the Club, twenty-eight members of other Societies, and nine visitors. Total, 65.

May 14th.

OBJECTS FOUND ON THE EXCURSION TO LOUGHTON, BY MESSRS. BURTON, PARSONS, AND ROUSSELET.

CRYPTOGAMIA.

ALGÆ. DESMIDIACEÆ.

Closterium acerosum.

Euastrum oblongum.

Micrasterias denticulata.

PROTOZOA.

Dinobryon, sp.

Glenodinium cinctum = *Peridinium cinctum.*

Mallomonas Ploslii.

Stentor niger.

,, *polymorphus.*

Trachelius ovum.

VERMES. ROTIFERA.

Anuræa aculeata.

,, *cochlearis.*

,, *curvicornis.*

,, *serrulatus.*

Asplanchna priodonta.

Brachionus angularis.

Conochilus volvox.

Copeus pachyurus.

Dinocharis pocillum.

,, *tetractis.*

Eosphora aurita.

Euchlanis dilatata.

,, *lyra.*

,, *triquetra.*

Floscularia cornuta.

Mastigocerca carinata.

,, *elongata.*

Melicerta conifera.

Notommata aurita.

Notops brachionus.

Polyarthra platyptera.

Pterodina cæca.

Triarthra longiseta.

Taphrocampa annulosa.

Attendance: Fourteen members of the Club, three members of others Societies, and two visitors. Total, 19.

May 28th.

OBJECTS FOUND ON THE EXCURSION TO PUTNEY HEATH, BY MESSRS. BURTON, PARSONS, AND ROUSSELET.

CRYPTOGAMIA.

ALGÆ. DESMIDIACEÆ.

Closterium didymotocum.

,, *lunula.*

,, *moniliferum.*

Hyalotheca dissiliens.

Micrasterias rotata.

Staurastrum dejectum.

,, *margaritaceum.*

PROTOZOA.

Ægyria oliva.

Amphileptus flagellatus.

Dinobryon sertularia.

Stentor polymorphus.

Urocentrum turbo.

VERMES. ROTIFERA.

Anuræa aculeata.

,, *cochlearis.*

Anuræa serrulata.
Asplanchna Brightwellii.
" *priodonta.*
Brachionus angularis.
" *pala.*
Diaschiza semi-aperta.
Dinocharis pocillum.
Euchlanis deflexa.
Monostyla lunaris.
Notommata aurita.
Notops hyptopus.
Polyarthra platyptera.
Rotifer macrurus.
" *vulgaris.*
Salpina marina (?).
Scaridium longicaudum.
Synchæta pectinata.
" *tremula.*

Attendance: Twelve members of the Club, two members of the South London M. and N. H. Club, and one visitor. Total, 15.

June 11th.

OBJECTS FOUND ON THE EXCURSION TO STAINES, BY MESSRS. BURTON, T. FARMER HALL, PARSONS, ROUSSELET, AND WESTERN.

PROTOZOA.
Actinosphærium Eichhornii.
Anthophysa vegetans.
Arcellus vulgaris.
Dinobryon sertularia.
Loxophyllum meleagris.
Ophridium sessile.
" *versatile.*
Phacus longicaudus.
Stentor niger.
" *polymorphus.*

VERMES. ROTIFERA.
Anuræa aculeata.
" *cochlearis.*
Asplanchna Brightwellii.
Asplanchnopus myrmeleo.
Brachionus pala.
" *rubens.*
Cathypna luna.
Conochilus volvox.
Copeus Ehrenbergii.
Dinocharis tetractis.
Eosphora digitata.
Euchlanis dilatata.
Euchlanis triquetra.
Floscularia algicola.
" *campanulata.*
" *ornata.*
Mastigocerca bicristata.
" *bicornis.*
" *carinata.*
Melicerta ringens.
Metopidia solidus.
" *triptera.*
Monocerca rattus.
Monura colurus.
Noteus quadricornis.
Notholca acuminata.
Notommata lacinulata.
" *naïas.*
" *tripus.*
Notops brachionus.
Œcistes mucicola.
" *stygis.*
Philodina megalotrocha.
Polyarthra platyptera.
Pterodina patina.
Rattulus sejunctipes.

Rotifer macrurus.
,, tardus.
Salpina brevispina.
Scaridium longicaudum.
Stephanops lamellaris.
,, muticus.
Stephanoceros Eichhornii.
Taphrocampa annulosa.
Triarthra longiseta.
,, mystacina.
Triphylus lacustris.

Attendance: Ten members of the Club and one member of the South London M. and N. H. Club. Total, 11.

June 25th.

Objects Found on the Excursion to Woking, by Messrs. Burton, T. Farmer Hall, Parsons, Rousselet, and Seligmann.

PHANEROGAMIA.
Alisma ranunculoides.
Asperula cynanchica.
Drosera longifolia.
,, rotundifolia.
Genista anglica.
Hypericum elodes.
Pedicularis palustris.
,, sylvatica.
Sarothamnus scoparius.

PROTOZOA.
Ægyria oliva.
Anthophysa vegetans.
Arcella vulgaris.
Difflugia pyriformis.
Dinobryon sertularia.
Rhipidodendron Huxleyi.
Spirostomum ambiguum.
Stentor niger.
,, polymorphus.
Trachelius ovum.
Urocentrum turbo.
Vaginicola crystallina.
Vorticella chlorostigma.

VERMES. Rotifera.
Anuræa cochlearis.
Brachionus Bakeri.
,, pala.
,, rubens.
,, urceolaris.
Cathypna luna.
Cœlopus tenuior.
Colurus caudatus.
Copeus cerberus.
,, Ehrenbergii.
Diglena grandis.
Dinocharis pocillum.
,, tetractis.
Eosphora aurita.
Euchlanis hyalina.
,, parva.
,, triquetra.
Floscularia campanulata.
,, ornata.
Furcularia micropus.
Hydatina senta.
Mastigocerca elongata.
Melicerta conifera.
,, ringens.
Microcodon clavus.
Monostyla bulla.
Notommata lacinulata.

Philodina aculeata.
,, *citrina.*
,, *macrostyla.*
Polyarthra platyptera.
Œcistes crystallinus.
,, *longicornis.*
,, *stygis.*
Rotifer hapticus.
,, *macrurus.*
,, *tardus.*
,, *vulgaris.*
Stephanoceros Eichhornii.
Synchæta longipes.
Synchæta tremula.
Taphrocampa Saundersiæ.
Triarthra longiseta.
CRUSTACEA. Entomostraca.
Polyphemus pediculus.
Sida crystallina.
ARACHNIDA. Arctisconidæ.
Macrobiotus Hufelandii.
MOLLUSCOIDA. Polyzoa.
Paludicella Ehrenbergii.
Plumatella repens.

Attendance: Eight members of the Club and one member of the South London M. and N. H. Club. Total, 9.

July 9th.

Objects Found on the Excursion to Oxshott, by Messrs. Burton, T. Farmer Hall, Parsons, and Western.

CRYPTOGAMIA.
ALGÆ. Desmidiaceæ.
Closterium lunula.
,, *moniliferum.*
,, *rostratum = acus.*
Micrasterias denticulata.
PROTOZOA.
Actinophrys viridis.
Amœba radiosa.
Arcella vulgaris.
Gyrocoris oxyura.
Paramecium aurelia.
Peridinium fuscum.
Rhipidodendron Huxleyi.
Spirostomum ambiguum.
Stentor niger.
,, *polymorphus.*
VERMES. Rotifera.
Anuræa aculeata.
Anuræa brevispina.
,, *curvicornis.*
,, *serrulata.*
,, *tecta.*
Asplanchna Brightwellii.
Brachionus angularis.
,, *Bakeri.*
,, *rubens.*
,, *urceolaris.*
Colurus bicuspidatus.
Copeus caudatus.
,, *pachyurus.*
Dinocharis pocillum.
,, *tetractis.*
Diglena biraphis.
Euchlanis dilatata.
,, *subversa* (Bryce).
,, *triquetra.*
Floscularia coronetta.

Floscularia cornuta, var., with short fleshy process or "horn" not projecting beyond the dorsal lobe.
Floscularia ornata.
Furcularia cæca.
,, *forficula*, var., with toes reversed, as in *Distemma forficula* (Ehr.).
Limnias myriophylli (Western) = *Limnioides myriophylli* (Tatem).
Metopidia solidus.
Monostyla Lordii.
Mytilia Tavina.
Notops brachionus.
Œcistes longicornis.
,, *mucicola.*
,, *pilula.*
,, *stygis.*
,, *umbella.*
Polyarthra platyptera.
Proales petromyzon.
Pterodina cæca.
Rotifer macroceros.
,, *mento.* ?
,, *vulgaris.*
Sacculus viridis.
Synchæta tremula.
Triarthra longiseta.

Attendance: Ten members of the Club and one member of the South London M. and N. H. Club. Total, 11.

July 23rd.

Objects Found on the Excursion to Richmond Park, by Messrs. Burton, Parsons, Rousselet, and Western.

PROTOZOA.
Centropyxis aculeata = *Arcella aculeata.*
Difflugia pyriformis.
Dinobryon sertularia.
Euplotes patella.
Stentor niger.
,, *polymorphus.*
Trachelius ovum.
Vorticella chlorostigma.

VERMES. Rotifera.
Anuræa aculeata.
,, *cochlearis.*
Asplanchna Brightwellii.
Brachionus angularis.
,, *dorcas.*
,, *urceolaris.*
Callidina musculosa.
Cathypna luna.
Colurus bicuspidatus.
Conochilus dossuarius.
Dinochari pocillum.
,, *tetractis.*
Distylis flexilis.
Euchlanis pyriformis.
,, *triquetra.*
Floscularia algicola.
,, *ornata.*
Furcularia longiseta.
Limnias ceratophyllii.
Mastigocerca bicornis.
,, *elongata.*
Melicerta ringens.
Monostyla cornuta.
Noteus quadricornis.
Œcistes mucicola.

Philodina citrina.
Proales parasita.
Pterodina patina.
,, *truncata.*
Rotifer vulgaris.
Sacculus viridis.
Stephanoceros Eichhornii.
Synchæta pectinata.
Triarthra longiseta.

CRUSTACEA. ENTOMOSTRACA.
Daphnia reticulata.
Diaptomus castor.
Sida crystallina.

MOLLUSCOIDA. POLYZOA.
Cristatella mucedo.
Fredericella sultana.
Plumatella repens.

Attendance: Eleven members of the Club, one member of the South London M. and N. H. Club, and one visitor. Total, 13.

September 17th.

OBJECTS FOUND ON THE EXCURSION TO CHINGFORD, BY MESSRS. BURTON, PARSONS, AND WESTERN.

PROTOZOA.
Dendrocometes paradoxus.
Epistylis Steinii.
Euglena viridis.
Stentor niger.
Trachelius ovum.

VERMES. ROTIFERA.
Adineta vaga.
Anuræa aculeata.
,, *brevispina.*
,, *cochlearis.*
,, *tecta.*
Asplanchna Brightwellii.
Brachionus Bakeri.
,, *pala.*
,, *rubens.*
,, *urceolaris.*
Calladina parasitica.
,, *plicata* (Bryce).
,, *quadricornifera.*
Cathypna luna.
Diglena catellina.
,, *giraffa.*
Eosphora digitata.
Euchlanis deflexa.
,, *triquetra.*
Furcularia ensifera. ♂ ♀
Mastigocerca carinata.
Metopidia acuminata.
Notops brachionus.
,, *hyptopus.*
Polyarthra platyptera.
Pompholyx complanata.
,, *sulcata.*
Rotifer macrurus.
,, *tardus.*
,, *vulgaris.*
Salpina mucronata.
,, *spinigera.*
Synchæta pectinata.
,, *tremula.*
Taphrocampa annulosa.
Triarthra breviseta.
,, *longiseta.*
Triphylus lacustris.

Attendance: Eleven members of the Club and one member of the South London M. and N. H. Club. Total, 12.

October 1st.

OBJECTS FOUND ON THE EXCURSION TO HAYES AND KESTON COMMONS, BY MESSRS. BURTON, PARSONS, AND WESTERN.

CRYPTOGAMIA.

ALGÆ. DESMIDIACEÆ.

Closterium didymotocum.
„ *lunula.*
„ *setaceum.*
Docidium baculum.
Euastrum ansatum.
„ *oblongum.*
Micrasterias crenata.
„ *rotata.*
Penium digitus.

PROTOZOA.

Amphileptus flagellatus.
Arcella vulgaris.
Bursaria truncatella.
Carchesium polypinum.
Chætospira mucicola.
Difflugia acuminata.
Dinobryon sertularia.
Euglypha ciliata.
Loxophyllum meleagris.
Nebela carinata.
„ *collaris.*
Spirostomum ambiguum.
Strombidium Claparedii.
Trachelius ovum.

VERMES. ROTIFERA.

Adineta vaga.
Albertia naidis.
Anuræa cochlearis.
„ *tecta.*
Asplanchna priodonta.
Brachionus urceolaris.
Callidina lata (Bryce).
„ *plicata* (Bryce).
Cathypna luna.
Conochilus unicornis.
Copeus cerberus.
„ *pachyurus.*
„ *spicatus.*
Dinocharis Collinsii.
Dinocharis pocillum.
„ *tetractis.*
Distyla flexilis.
Elosa Wooralii (Lord).
Euchlanis triquetra.
Floscularia campanulata.
„ *coronetta.*
„ *ornata.*
Furcularia æqualis.
„ *ensifera.*
„ *forficula.*
„ *gracilis.*
„ *longiseta.*
Mastigocerca bicornis.
Metopidia lepadella.
„ *triptera.*
Monostyla lunaris.
„ *quadridentata.*
Noteus quadricornis.
Notops brachionus.
Pedalion mirum.
Philodina citrina.
„ *macrostyla.*
Polyarthra platyptera.
Pompholyx sulcata.
Proales petromyzon.
Rotifer hapticus.
„ *macroceros.*
„ *Ræperi.*

Sacculus viridis.
Salpina mucronata.
Scaridium longicaudum.
Stephanops stylatus.
Synchæta pectinata.
Taphrocampa annulosa.
Triarthra longiseta.
GASTROTRICHA.
Dasydytes goniathrix (found here last year also).
OLIGOCHÆTA.
Nais proboscidea.

Attendance: Six members of the Club.

On 4th Feb., 1893, the very rare rotifer, *Floscularia edentata*, was found in a gathering taken at Keston on this excursion.

FREDK. A. PARSONS,
Hon. Sec. Excursions Sub-Com.

ERRATA.

Q.M.C. Excursions, 1891.

Page 86, read *Limnioides myriophylli*, and
Mastigocerca bicristata.
Page 87, read *Notommata cyrtopus* and
Noctiluca miliaris.
Ophiura and *Solaster papposa* should be under *ECHINODERMATA*, and *Spirorbis communis* should be under *VERMES.*
Page 89, read *Brachionus dorcas.*

OFFICERS AND COMMITTEE.

(Elected February, 1893.)

President.

Edward Milles Nelson, F.R.M.S.

Vice-Presidents.

Rev. W. H. Dallinger, LL.D., F.R.S., F.R.M.S., &c., &c.
Prof. B. T. Lowne, F.R.C.S., F.L.S., &c.
A. D. Michael, Pres.R.M.S., F.L.S., &c.
Prof. C. Stewart, M.R.C.S., Pres.L.S., F.R.M.S., &c.

Committee.

J. W. Reed, F.R.M.S.
J. Spencer, F.R.M.S.
T. F. Smith, F.R.M.S.
G Mainland, F.R.M.S.
H. Morland.
E. Dadswell, F.R.M.S.
J. G. Waller, F.S.A.
F. A. Parsons.
F. W. Hembry, F.R.M.S.
E. T. Browne, F.R.M.S.
G. Western, F.R.M.S.
E. T. Newton, F.G.S.

Hon. Treasurer.

J. J. Vezey, F.R.M.S., 21, Mincing Lane, E.C.

Hon. Secretary.

G. C. Karop, M.R.C.S., F.R.M.S., 198, Holland Road, Kensington, W.

Hon. Sec. for Foreign Correspondence.

C. Rousselet, F.R.M.S., 27, Great Castle Street, Regent Street, W.

Hon. Reporter.

R. T. Lewis, F.R.M.S., 4, Lyndhurst Villas, The Park, Ealing, W.

Hon. Librarian.

Alpheus Smith,
8, Hanover Park, Peckham, S.E.

Hon. Curator.

Charles Emery,
10, Barrington Road, Crouch End, N.

PAST PRESIDENTS.

		Elected.
*EDWIN LANKESTER, M.D., F.R.S. - -	July,	1865.
ERNEST HART - - - - - - -	,,	1866.
ARTHUR E. DURHAM, F.R.C.S., F.L.S., &c.	,,	1867.
,, ,, ,, ,, - -	,,	1868.
*PETER LE NEVE FOSTER, M.A. - -	,,	1869.
LIONEL S. BEALE, M.B., F.R.S., &c. - -	,,	1870.
,, ,, ,, ,, - -	,,	1871.
ROBERT BRAITHWAITE, M.D., F.L.S., &c.	,,	1872.
,, ,, ,, ,, - -	,,	1873.
*JOHN MATTHEWS, M.D., F.R.M.S. - -	,,	1874.
,, ,, ,, ,, - -	,,	1875.
*HENRY LEE, F.L.S., F.G.S., F.R.M.S., F.Z.S.	,,	1876.
,, ,, ,, ,, - -	,,	1877.
THOS. H. HUXLEY, LL.D., F.R.S., &c. - -	,,	1878.
*T. SPENCER COBBOLD, M.D., F.R.S., F.L.S., &c.		1879.
T. CHARTERS WHITE, M.R.C.S., L.D.S., &c.	,,	1880.
,, ,, ,, ,, - -	,,	1881.
M. C. COOKE, M.A., LL.D., A.L.S. ,, - -	,,	1882.
,, ,, ,, ,, - -	,,	1883.
*W. B. CARPENTER, C.B., F.R.S., &c., &c. -	,,	1884.
A. D. MICHAEL, F.L.S., P.R.M.S., &c. - -	,,	1885.
,, ,, ,, ,, - -	,,	1886.
,, ,, ,, ,, - -	Feb.,	1887.
B. T. LOWNE, F.R.C.S., F.L.S., &c. - - -	,,	1888.
,, ,, ,, - -	,,	1889.
Rev. W. H. DALLINGER, LL.D., F.R.S., F.R.M.S., &c., &c. - - - - -	,,	1890.
,, ,, ,, ,, ,,	,,	1891.
,, ,, ,, ,, ,,	,,	1892.

* Deceased.

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868.	Arthur Mead Edwards, M.D., 11, Washington street, Newark, New Jersey, U.S.A.
Mar. 19, 1869.	The Rev. E. C. Bolles, Salem, Mass., U.S.A.
July 26, 1872.	Professor Hamilton L. Smith, Hon. F.R.M.S., President of Hobart College, Geneva, New York, U.S.A.
July 23, 1875.	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c. (*Past President*), 61, Lower Grosvenor street, W.
Sept. 22, 1876.	Frederick Kitton, Hon. F.R.M.S., &c., 8, West Kensington terrace, W.
July 25, 1879.	Dr. E. Abbe, Hon.F.R.M.S., Jena, Saxe Weimar, Germany.
July 23, 1880.	F. H. Wenham, C.E., 112, New Bond street, W.
Nov. 24, 1882.	Dr. Veit B. Wittrock, Professor at the Royal Academy of Sciences, and Director of the Museum of Natural History, Stockholm, Sweden.
Feb. 17, 1893.	Robert Braithwaite, M.D., F.L.S., F.R.M.S. (*Past President*), The Ferns, 303, Clapham road, S.W.
Feb. 17, 1893.	M. C. Cooke, M.A., LL.D., A.L.S. (*Past President*), 146, Junction road, Upper Holloway, N.
Feb. 17, 1893.	A. E. Durham, F.R.C.S., F.L.S., F.R.M.S. (*Past President*), 82, Brook street, Grosvenor square, W.
Feb. 17, 1893.	Right Hon. Prof. T. H. Huxley, P.C., LL.D., F.R.S., Hon.F.R.M.S., etc. (*Past President*), Hodeslea, Eastbourne.
Feb. 17, 1893.	T. Charters White, M.R.C.S., L.D.S., F.R.M.S. (*Past President*), 26, Belgrave road, S.W.
Feb. 17, 1893.	Prof. W. C. Williamson, LL.D., F.R.S., Hon.F.R.M.S., etc., 43, Elms road, Clapham, S.W.

LIST OF MEMBERS.

Date of Election.	
Feb. 20, 1891.	Addis, W., 44, Herbert street, New North road, N.
Nov. 23, 1888.	Alabaster, J. H., The Hollies, King's road, Richmond, Surrey.
Feb. 19, 1892.	Albany, J., 17, Amersham road, New Cross, S.E,
April 18, 1890.	Allen, J. M., F.R.M.S., 11, Gray's Inn square, W.C.
Nov. 21, 1890.	Allen, R., M.A., 5, Addison road, Plymouth.
Dec. 17, 1869.	Ames, G. A., F.R.M.S., Union Club, Trafalgar square, S.W.
Dec. 22, 1865.	Andrew, F. W., 3, Neville terrace, Onslow gardens, S.W.
Dec. 18, 1891.	Arnold, H. R., 8, Durley road, Stamford hill, N.
Feb. 22, 1889.	Ashe, A., Roman villa, Laurie square, Romford, Essex.
Dec. 27, 1867.	Bailey, J. W., 75, Broke road, Dalston, E.
April 24, 1868.	Baker, Charles, F.R.M.S., 244, High Holborn, W.C.
Jan. 20, 1893.	Baker, C. Ashmore, 47, Russell road, Kensington, W.
Dec. 27, 1872.	Barnard, Herbert, 23, Portland place, W.
April 22, 1870.	Barnes, C. B., Florencedale, Selhurst road, South Norwood, S.E., and 27, Clement's lane, E.C.
May 25, 1883.	Barratt, Thomas J., Bell Moor house, Upper Heath, Hampstead, N.W.
Sept. 27, 1872.	Bartlett, Edward, L.D.S., M.R.C.S.E., 38, Connaught square, W.
June 17, 1892.	Bates, C., 94, Rectory road, Stoke Newington, N.
June 19, 1891.	Bates, W., 98, Wickham road, Brockley, S.E.
Jan. 16, 1891.	Baxter, W. E., F.R.M.S., 170, Church street, Stoke Newington, N.

Date of Election.	
June 19, 1891.	Baxter, F. W., 170, Church street, Stoke Newington, N.
Nov. 26, 1875.	Beaulah, John, Raventhorpe, Brigg.
July 25, 1884.	Beck, C., F.R.M.S., 68, Cornhill, E.C.
June 19, 1891.	Beck, Horace C., 233, Albion road, Stoke Newington, N.
Mar. 28, 1884.	Beetham, A., 11, South square, Gray's Inn, W.C.
June 17, 1892.	Benest, E., 52, King square, Goswell road, E.C.
Feb. 19, 1892.	Bernard, H. M., M.A., F.Z.S., "Landgrafen," Babington road, Streatham, S.W.
Dec. 18, 1891.	Bessell, J. B., F.R.M.S., 8, Elmgrove road, Cotham, Bristol.
Oct. 23, 1868.	Bevington, W. A., F.R.M.S., "Avondale," Coloraine road, Blackheath, S.E.
Mar. 18, 1892.	Black, T. F., 14, Mount View road, Crouch Hill, N.
Feb. 23, 1866.	Blake, T., 41, Finsbury Circus, E.C.
July 27, 1877.	Blenkinsop, B., Shord hill, Kenley, Surrey.
May 26, 1876.	Blundell, J. W., Stock Exchange, E.C.
Nov. 23, 1883.	Bostock, E., F.R.M.S., "The Radfords," Stone, Staffordshire.
April 17, 1891.	Bradford, W. B., 23, Thornford road, Lewisham park, S.E.
Feb. 23, 1892.	Brooke, W. R., Meadow Lodge, Grove road, Walthamstow, Essex.
Dec. 19, 1890.	Brough, J. R., 29, Alexandra villas, Finsbury park, N.
Feb. 19, 1892.	Brown, W. H., 3, Lavender road, Sutton, Surrey.
Mar. 18, 1892.	Brown, W. H., 20, Hanover square, W.
May 22, 1868.	Brown, W. J., 17, Maple road, Anerley, S.E.
Jan. 28, 1887.	Browne, E. T., F.R.M.S., Uxbridge lodge, Uxbridge road, Shepherd's Bush, W.
May 28, 1875.	Browne, J. W., Frascati, Masons hill, Bromley, Kent.
Jan. 15, 1892.	Bryce, D., 37, Brooke road, Stoke Newington common, N.
May 22, 1885.	Buckland, H., Hill View, High road, Sidcup, Kent.
Jan. 26, 1877.	Buffham, T. H., A.L.S., Hughenden villa, Comley Bank road, Walthamstow.

Date of Election.

May 16, 1890. Bull, J. M., B.A., 25, Goldhurst terrace, South Hampstead, N.W.

Feb. 19, 1892. Burgess, H., Physiological Laboratory, King's College, Strand, W.C.

Aug. 22, 1879. Burton, William, 27, Wigmore street, W.

June 14, 1865. Bywater, W. M., F.R.M.S., 5, Hanover square, W.

May 24, 1889. Carnell, A. A., Bedford villa, Plymouth.

May 23, 1879. Carpenter, H. S., Beckington house, Weighton road, Anerley, S.E.

May 26, 1882. Chapman, W. Ingram, 24, Dalebury road, Upper Tooting, S.W.

June 17, 1892. Challoner, G., F.C.S., 30, Weston Park, Crouch End, N.

Dec. 27, 1878. Chatto, Andrew, 214, Piccadilly, W.

Dec. 16, 1892. Cheshire, W., Stirling villa, Sutton.

Mar. 22, 1878. Chester, The Very Rev. the Dean of, The Deanery, Chester.

Dec. 18, 1891. Cheyne, A. M., 16, Coleman street, E.C.

Nov. 27, 1874. Chippendale, George, 3, East Field Rise, Hoe street, Walthamstow.

Dec. 27, 1881. Claremont, Claude Clarke, M.R.C.S., Millbrooke house, Hampstead road, N.W.

Feb. 23, 1883. Clark, Joseph, F.R.M.S., Hind Hayes, Street, Somerset.

Dec. 19, 1890. Coghill, P. D., F.R.M.S., Royal Veterinary College, N.W.

Dec. 18, 1891. Collins, H. S., 844, Old Kent road, S.E.

May 28, 1869. Cottam, Arthur, F.R.A.S., H.M.Office of Works, Whitehall place, S.W.

July 26, 1872. Cowan, F. W., F.L.S., F.G.S., F.R.M.S., 31, Belsize Park gardens, Hampstead, N.W.

Aug. 28, 1868. Crisp, Frank, LL.B., B.A., *V.P. and Treas. Linnean Society;* 5, Lansdowne road, Notting hill, W.

Dec. 23, 1870. Crisp, J. S., F.R.M.S., Ashville, Lewin road, Streatham, S.W.

Feb. 23, 1877. Crofton, Edward, M.A.Oxon., F.R.M.S., 45, West Cromwell road, Earl's Court, S.W.

Date of Election.

May 15, 1891. Croger, T. R., 8, Marquess road, Canonbury, N.
June 25, 1880. Curties, C. Lees, 244, High Holborn, W.C.
May 25, 1866. Curties, Thomas, F.R.M.S., 244, High Holborn, W.C.
June 25, 1880. Curties, W. Irvin, 244, High Holborn, W.C.
Sept. 26, 1879. Curtis, Charles, 29, Baker street, Portman sq., W.

Jan. 22, 1875. Dadswell, E., F.R.M.S., 21, Montrell road, Streatham hill, S.W.
Feb. 23, 1883. DALLINGER, Rev. W. H., LL.D., F.R.S., F.R.M.S., &c. (*Past President*), Ingleside, Newstead road, Lee, S.E.
May 23, 1879. Dallmeyer, T. R., 25, Newman street, Oxford street, W.
Mar. 18, 1892. Daniell, J. A., 23, Queen Victoria street, E.C.
May 22, 1878. Darke, Edward, 16, Rochester terrace, Camden road, N.W.
June 17, 1892. Davies, T., L.R.C.P.Ed., M.R.C.S., 71, Comeragh road, West Kensington, W.
Nov. 23, 1888. Davis, H. R., Thistleton house, 1, Clissold road, Stoke Newington.
May 23, 1879. Dawson, W., F.R.M.S., Mustow house, Bury St. Edmunds, Suffolk.
May 28, 1875. Dean, Arthur (*Hon. Sec. East Lond. Mic. Soc.*), 57, Southborough road, South Hackney, E.
Jan. 24, 1879. Deby, Julien, C.E., F.R.M.S., 31, Belsize avenue, St. John's wood, N.W.
Mar. 22, 1889. Dick, J., 39, Lowman road, Holloway, N.
Jan. 20, 1893. Dineen, George Peter, 62, Strode road, Willesden Green, N.W.
June 17, 1892. Dixon-Nuttall, F. R., F.R.M.S., Queen's park, St. Helen's, Lancashire.
May 25, 1883. Drake, C. A., The Distillery, Three Mill lane, Bromley-by-Bow.
Oct. 25, 1872. Dunning, C. G., 55. Camden park road, N.W.

June 19, 1891. Earland, Arthur, 3, Eaton grove, Dacre park, Lee, S.E.
Sept. 25, 1868. Eddy, J. R., F.R.M.S., F.G.S., The Grange, Carleton, Skipton, Yorkshire.

Date of Election.

Mar. 18, 1892. Elliott, J., 4, The Beacon, Exmouth.
May 26, 1876. Emery, Charles (*Hon. Curator*), 10, Barrington road, Crouch end, N.
Feb. 28, 1879. Epps, Hahnemann, 95, Upper Tulse hill, Brixton, S.W.
Feb. 21, 1884. Epps, J., jun., Norfolk house, Beulah hill, Upper Norwood, S.E.
Dec. 18, 1891. Evans, F. H., 77, Queen street, E.C.
Sept. 16, 1892. Eyre, F. W., Inland Revenue Department, Somerset house, W.C.

July 25, 1873. Fase, Rev. H. J., M.A., 8, Dents road, Wandsworth common, S.W.
Jan. 28, 1876. Faulkner, John, L.D.S., 41, Upper Baker street, N.W.
Feb. 17, 1893. Fenner, T. D., Calton house, Honor Oak road, Forest Hill.
Aug. 25, 1882. Field, W. H., 39, Crouch Hill road, Crouch end, N.
June 17, 1892. Finlayson, D., 117, Avenell road, Highbury, N.
July 26, 1867. Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh house, Highbury New park, N.
Nov. 23, 1889. Fletcher, C., F.R.M.S., 11, Canfield gardens, West Hampstead, N.W.
Feb. 24, 1888. Fletcher, W. W., The Laurels, Worsley road, Hampstead, N.W.
Nov. 23, 1888. Flood, W. C., 55, Aubert park, Highbury, N.
Mar. 24, 1871. Foulerton, John, M.D., 44, Pembridge villas, Bayswater, W.
June 23, 1871. Freeman, H. E., 104, Shaftesbury road, Crouch hill, N.
May 22, 1868. Fryer, G. H., Westhaven, Cricklewood, N.W.
July 23, 1880. Funston, James, 93, Finsbury pavement, E.C.

June 20, 1890. Galton, J. C., M.A., F.L.S., New University Club, St. James' street, S.W.
Mar. 25, 1870. Garden, R. S., 42, Carlton hill, St. John's wood, N.W.
July 7, 1865. Gay, F. W., F.R.M.S. 113, High Holborn, W.C.

Date of Election.	
July 26, 1867.	George, Edward, F.R.M.S., Vernon house, Westward park, Forest hill, S.E.
May 16, 1890.	Gill, C. H., F.R.M.S., Berkeley lodge, Stroude road, Staines.
April 17, 1891.	Gladstone, C. E., Commander R.N., 13, Arlington street, S.W.
Jan. 15, 1892.	Goffi, G., 321, Earlsfield road, Wandsworth common, S.W.
April 26, 1872.	Goodinge, J. W., F.R.G.S., F.R.M.S., 119, High Holborn, W.C.
Nov. 23, 1877.	Goodwin, William, 18, Sunnyside road, N.
Aug. 24, 1885.	Greenhough, D. W., 212, Lewisham High road, St. John's, S.E.
Oct. 23, 1868.	Greenish, Thomas, F.R.M.S., 20, New street, Dorset square, N.W.
Sept. 27, 1889.	Grenfell, J. G., B.A., F.R.M.S., 12, John street, Bedford row, W.C.
Feb. 17, 1893.	Grocock, Leonard Oakley, 21, Beckenham road, Penge, S.E.
Jan. 28, 1887.	Grove, E., F.R.M.S., Norlington, Preston, Brighton.
July 24, 1868.	Groves, Prof. J. W., F.R.M.S., The Hermitage, Tunbridge Wells.
July 24, 1868.	Grubbe, E. W., C.E., 5, Chepstow place, Bayswater, W.
Jan. 27, 1871.	Guimaraens, A. de Souza, F.R.M.S., 52, Lowden road, Herne hill, S.E.
Sept. 28, 1877.	Hagger, John, Repton school, Burton-on-Trent.
Feb. 3, 1867.	Hainworth, William, 70, Fountayne road, Stoke Newington, N.
Mar. 18, 1892.	Halford, F. M., 6, Pembridge place, Bayswater, W.
Sept. 28, 1888.	Hall, T. F., 2, Observatory gardens, Kensington, W.
Dec. 28, 1866.	Hallett, R. J., 163, Seymour street, Euston square, N.W.
Feb. 22, 1869.	Hammond, A., F.L.S., 30, Versailles road, Anerley, S.E.

Date of Election.

Oct. 22, 1886.	Hampton, W., 38, Lichfield street, Hanley, Staffordshire.
July 25, 1879.	Hardingham, G. G., F.R.B.S., Carrownaffe, Albany road, Southsea, Hants.
Sept. 16, 1892.	Hardy, W. H., Rookwood, Torrington park, North Finchley, N.
Jan. 23, 1874.	Hardy, J. D., 73, Clarence road, Clapton, E., and 4, Lombard street, E.C.
Sept. 28, 1866.	Harkness, W., F.R.M.S., Laboratory, Somerset house, W.C.
April 23, 1875.	Harrison, James, 150, Akerman road, North Brixton, S.W.
Mar. 28, 1879.	Hawkins, C. E., 1, Gable villas, East street, Havant.
June 28, 1867.	Hawksley, T. P., 97, Adelaide road, N.W.
June 22, 1883.	Haselwood, Jas. Edmund, F.R.M.S., 3, Lennox place, Brighton.
Aug. 23, 1872.	Hembry, F. W., F.R.M.S., Sussex Lodge, Sidcup, Kent.
June 26, 1868.	Henry, A. H., 73, Redcliffe gardens, S.W.
Feb. 26, 1886.	Hewlett, R. T., Bacteriological Laboratory, King's College, Strand, W.C.
Jan. 16, 1891.	Hicks, J. H. A., Seymour house, Bourke road, Willesden, N.W.
April 25, 1884.	Higgins, J., London University, Burlington gardens, W.
April 17, 1891.	Hill, H., 5, Park Lodge villas, East Finchley, N.
Sept. 24, 1869.	Hilton, T. C. D., M.D., Upper Deal, Kent.
May 22, 1874.	Hind, George, 244, High Holborn, W.C.
Oct. 21, 1892.	Hinds, Thos. W., School for the Blind, Swiss cottage, N.W.
Jan. 15, 1892.	Hogan, H. S., 13, Park road, Wimbledon.
Feb. 26, 1875.	Holford, Christopher, Bounty Office, Dean's yard, Westminster, S.W.
Nov. 26, 1880.	Hopkins, Robert, Shearn villa, Walthamstow, Essex.
Oct. 26, 1866.	Horncastle, Henry, Ashlawn, Hamlet road, Upper Norwood, S.E.
June 17, 1892.	Hoskins, A. B., A.M.Inst.C.E., 7, Northbrook road, Lee, S.E.

Date of Election.	
May 22, 1874.	Hovenden, C. W., F.R.M.S., 95, City road, E.C.
April 26, 1867.	Hovenden, Frederick, F.R.M.S., Glenlea, Thurlow park road, Dulwich, S.E.
April 17, 1891.	Howard, A. D., F.R.M.S., 3, Dartmouth row, Blackheath, S.E.
Oct. 27, 1876.	Howard, D., Hungershall Lodge, Tunbridge Wells, Kent.
Sept. 23, 1887.	Hughes, F. T. M., Chelmsford villa, Parkhurst road, New Southgate, N.
May 28, 1886.	Hughes, W., 32, Heathland road, Stoke Newington, N.
Feb. 17, 1893.	Hunt, John, "Fingarry," Milton of Campsie, near Glasgow.
July 25, 1873.	Hurst, J. T., 1, Raymond villas, Geraldine road, Wandsworth, S.W.
May 24, 1867.	Ingpen, J. E., F.R.M.S., 7, The Hill, Putney, S.W.
July 24, 1868.	Jackson, F. R., Culver cottage, Slindon, Arundel, Sussex.
Aug. 25, 1882.	Jakeman, Christopher, Bouldner Lodge, Lewisham hill, S.E.
Feb. 27, 1885.	Jaques, E. K., 36, Old Gravel lane, St. George's, E.
June 14, 1865.	Jaques, Edward, B.A., 48, Ashley road, Crouch hill, N.
May 15, 1891.	Jeakes, Rev. J., The Rectory, Hornsey, N.
May 15, 1891.	Jeakes, Rev. J. M., The Rectory, Hornsey, N.
Nov. 23, 1888.	Jefferys, T. G., 11, Edith road, St. Mary's road, Peckham, S.E.
Oct. 26, 1888.	Jenkins, A. J., 6, Douglas terrace, Douglas street, Deptford, S.E.
Feb. 24, 1871.	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379, Euston road, N.W.
June 20, 1890.	Johnson, T. T., 141, Charing Cross road, W.C.
Sept. 18, 1891.	Johnson, W., F.R.M.S., 188, Tottenham Court road, W.C.
Dec. 18, 1891.	Jones, A. W., 51, Shawfield street, Chelsea, S.W.

Date of Election.

May 23, 1873. Karop, G. C., M.R.C.S., F.R.M.S., etc. (*Hon Secretary*), 198, Holland road, Kensington, W.
June 19, 1891. Kelley, F. J., The Homestead, Sutton, Surrey.
July 25, 1884. Kern, J. J., Fern Glen, Selhurst park, South Norwood, S.E.
Feb. 20, 1891. King, H. W., Stanford, Muswell avenue, Muswell hill, N.
Feb. 28, 1873. Kitsell, F. J., 24, St. Stephen's avenue, Goldhawk road, Shepherd's Bush, W.
Mar. 22, 1889. Klein, S. T., The Red House, Stanmore.

May 28, 1875. Larkin, J., Delrow, Aldenham, near Watford.
Feb. 24, 1888. Lathangue, R., 117, Darenth road, Stamford hill, N.
Mar. 22, 1889. Latham, J. W., High street, Romford, Essex.
June 20, 1890. Lawson, K., 12, Harley street, W.
June 25, 1869. Layton, C. E., Farringdon street, E.C.
Aug. 28, 1868. Leaf, C. J., F.L.S., F.R.M.S., etc., 6, Sussex place, Regent's park, N.W.
Nov. 25, 1887. Lewer, J. J., 20, Crossfield road, Belsize park, N.W.
April 27, 1866. Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 4, Lyndhurst villas, The Park, Ealing, W.
June 26, 1868. Lindley, W. H., jun., 29, Blittersdorffs platz, Frankfort-on-Maine.
Mar. 20, 1891. Lloyd, H. W., 51, Camden square, N.W.
Sept. 16, 1892. Lösecke, S. von, 30, Delancey street, N.W.
April 17, 1891. Loughborough, A. E., 8, Holland Park gardens, W.
Nov. 24, 1866. Lovibond, J. W., F.R.M.S., St. Anne street, Salisbury.
Sept. 23, 1887. Lowne, B. T., F.R.C.S., F.L.S., etc. (*Past President*), 18, St. Quintin avenue, North Kensington, N.W.
Oct. 21, 1892. Luscombe, J. Luscombe, 5, St. Mary's terrace, Paddington.

Mar. 22, 1889. Machin, C. J., 55, Parliament Hill road, Hampstead, N.W.
Nov. 23, 1866. McIntire, S. J., 14, Hetley road, Uxbridge road, Shepherd's Bush, W.

Date of Election.	
Jan. 23, 1880.	Mackenzie, James, 17, Lammas Park road, Ealing, W.
Jan. 24, 1884.	Macrae, A. C., M.D., 119, Westbourne terrace, Hyde park, W.
May 25, 1883.	Mainland, G. E., F.R.M.S., Terrace house, Woodside lane, North Finchley, N.
May 25, 1883.	Mais, H. T. Coathorpe, M.I.C.E., Engineer-in-Chief, 61, Queen street, Melbourne, South Australia.
Mar. 18, 1892.	Marriott, Rev. E. P., 19, Springfield terrace, Lancaster.
Sept. 16, 1892.	Martin, H. S., Normanhurst, New Beckenham, S.E.
April 26, 1867.	Matthews, G. K., St. John's lodge, Beckenham, Kent.
Jan. 15, 1892.	Maw, W. H., F.R.M.S., F.R.A.S., 18, Addison road, Kensington, W.
May 26, 1871.	May, J. W., F.R.M.S., Arundel house, Percy-cross, Fulham, S.W.
May 22, 1874.	Messenger, G. A., Lloyds, E.C.
July 27, 1877.	MICHAEL, A. D., F.L.S., P.R.M.S. (*Past President*), Cadogan Mansions, Sloane square, Chelsea, S.W.
July 7, 1865.	Millett, F. W., F.R.M.S., Marazion, Cornwall.
Jan. 15, 1892.	More, J., jun., F.R.M.S., 49, Orlando road, Clapham, S.W.
July 26, 1878.	Morland, Henry, Cranford, near Hounslow.
Jan. 16, 1891.	Muiron, C., F.R.M.S., 20, Benbow road, Hammersmith, W.
June 19, 1891.	Mummery, J. Howard, M.R.C.S., F.R.M.S., 1, Holly terrace, West hill, Highgate.
Mar. 24, 1876.	NELSON, E. M., F.R.M.S. (*President*), 66, West End lane, West Hampstead, N.W.
Nov. 25, 1881.	Nevins, R. T. G., F.R.M.S., Pembroke lodge, Hildenborough, Tonbridge.
Jan. 26, 1872.	Newton, E. T., F.G.S., Geological Museum, Jermyn street, S.W.

Date of Election.

Dec. 28, 1888. Oakden, C. H., 51, Melbourne grove, East Dulwich, S.E.
Jan. 24, 1879. Offord, J. M., F.R.M.S., 15, Loudoun road, St. John's Wood, N.W.
Dec. 22, 1876. Ogilvy, C. P., F.L.S., Sizewell house, Leiston, near Saxmundham, Suffolk.
Nov. 18, 1892. Orfeur, Frank, 91, Effra road, Brixton, S.W.
Dec. 27, 1867. Oxley, Frederick, F.R.M.S., 8, Crosby square, Bishopsgate street, E.C.

Feb. 17, 1893. Palmer, Fred John Morton, M.B. (Lond.), M.R.C.S., etc., Christwell, Riggindale road, Streatham, S.W.
June 20, 1890. Parry, J., 58, East street buildings, Manchester square, W.
Oct. 27, 1871. Parsons, F. A., 15, Osborne road, Finsbury park, N.
July 23, 1886. Paul, R., Madeira cottage, Lyme Regis.
April 23, 1875. Peal, C. N., F.R.M.S., F.L.S., Fernhurst, Mattock lane, Ealing, W.
July 22, 1887. Pearce, G., F.R.M.S., Brabourne Haigh, Highwood hill, N.W.
May 24, 1867. Pearson, John, 3, Westbourne grove, W.
July 22, 1881. Perigal, Henry, F.R.M.S., F.R.A.S., 9, North crescent, Bedford square, W.C.
Jan. 15, 1892. Pierce, W. J., 1, Crawshay road, North Brixton, S.W.
April 18, 1890. Pinnock, A., 5, Bow Church yard, E.C.
Sept. 27, 1878. Plomer, G. D., Rohais, Enys road, Eastbourne.
Nov. 23, 1883. Plowman, T., jun., Nystuen lodge, Bycullah park, Enfield.
Sept. 28, 1877. Pocklington, Henry, F.R.M.S., 20, Park road, Leeds.
Nov. 23, 1866. Potter, George, F.R.M.S., 66, Grove road, Holloway, N.
Jan. 25, 1878. Potts, R. A., 26, South Audley street, W.
June 24, 1881. Potts, William, 157, Winchester house, Old Broad street, E.C.
Mar. 21, 1890. Pound, C. J., F.R.M.S., Medical School, University, Sydney.

Date of Election.	
June 22, 1866.	Powe, I., 76, St. George's street, Richmond, Surrey.
April 25, 1879.	Powell, H. P., Mill Platt, Isleworth.
Feb. 19, 1892.	Powell, T. A. G., 18, Old Burlington street, W.
July 7, 1865.	Powell, Thomas H., F.R.M.S., 18, Doughty street, Mecklenburg square, W.C.
Nov. 18, 1892.	Pratt, Rev. J. S., St. Stephen's Vicarage, Albert square, S.W.
June 17, 1892.	Presland, E. B., 70, Galveston road, Putney, S.W.
May 24, 1889.	Preston, H. B., F.R.M.S., 47, Lexham gardens, Kensington, W.
June 27, 1873.	Priest, B. W., 22, Parliament street, S.W.
April 27, 1888.	Pringle, A., F.R.M.S., Cromwell House, Bexley Heath, S.E.
May 23, 1879.	Pritchard, J. D., Crymlyn Burrows, near Swansea.
Feb. 25, 1881.	Probyn, Clifford, 55, Grosvenor street, W.
May 15, 1891.	Pückert, H., 22, St. Charles' square, Notting hill, W.
May 16, 1890.	Pyman, F. H., Raithwaite, Old Park estate, Enfield, N.
Oct. 26, 1866.	Rabbits, W. T., F.L.S., 6, Cadogan gardens, S.W.
June 25, 1875.	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866.	Ramsden, Hildebrand, M.A.Cantab., F.L.S., F.R.M.S., 26, Upper Bedford place, Russell square, W.C.
Aug. 28, 1868.	Rance, T. G., Elmside, Bickley, Kent.
June 24, 1881.	Ransom, F., 12, Bancroft, Hitchin.
June 22, 1877.	Reed, J. W., F.R.M.S., F.R.G.S., 17, Colebrook row, Islington, N.
June 27, 1873.	Reeve, Frederick, 113, Clapham road, S.W.
Mar. 20, 1891.	Reynolds, Rev. H. W., M.A., Sydney House, St. Paul's road, N.W.
Sept. 18, 1891.	Richards, F. W., 114, St. Peter's street, Montreal, Canada.
Mar. 25, 1887.	Robinson, I., Hertford.
May 20, 1892.	Robinson, J., F.C.S., F.I.C., Ellesmere mansions, Canfield gardens, Hampstead, N.W.

Date of Election.

May 22, 1868. Rogers, John, F.R.M.S., 4, Tennyson street, Nottingham.

May 22, 1868. Roper, Freeman, C.S., F.L.S., F.R.M.S., F.G.S., Palgrave House, Eastbourne, Sussex.

Jan. 24, 1884. Rosseter, T. B., F.R.M.S., Fleur de Lis, Canterbury.

Jan. 26, 1883. Rousselet, Charles, (*Hon. Secretary for Foreign Correspondence*), F.R.M.S., 27, Great Castle street, Regent street, W.

April 27, 1888. Russell, J., 1, Deemount terrace, Aberdeen.

Oct. 27, 1865. Russell, James, Merton lodge, Freeland road, Ealing Common, W.

Jan. 15, 1892. Rutherford, Vety. Captain C., F.R.C.V.S., Army Veterinary Department, Aldershot.

Dec. 17, 1869. Salmon, John, 169, Hampstead road, N.W.

Feb. 19, 1892. Samson, W. E., 55, Bensham Manor road, Thornton heath.

Nov. 18, 1892. Sandall, Leonard, 92, Ballater road, Acre lane, Brixton, S.W.

May 20, 1892. Sargeant, A. J., The Retreat, Bensham Manor road, Thornton heath.

Jan. 16, 1890. Scherren, H., F.Z.S., 5, Osborne road, Stroud green, N.

June 20, 1890. Scourfield, D. J., 5, Yale terrace, Coleworth road, Leytonstone, E.

Mar. 22, 1889. Scriven, J. B., Brigade Surgeon, 95, Oxford gardens, North Kensington, W.

Mar. 18, 1892. Seligmann, C. G., F.R.M.S., 26, Clifton gardens, Maida hill, N.W.

July 23, 1880. Shaw, H. V., 10, Norfolk terrace, Western road, Brighton, Sussex.

May 26, 1876. Shepheard, Thomas, F.R.M.S., Kingsley lodge, Chester.

Mar. 20, 1891. Shrubsole, W. H., F.G.S., 62, High street, Sheerness-on-Sea.

Sept. 18, 1891. Siggs, F. L., Medical School, Middlesex Hospital, W.C.

May 26, 1871. Sigsworth, J. C., F.R.M.S., 20, Tedworth square, Chelsea, S.W.

Date of Election.

Mar. 23, 1888.	Simmonds, H. M., M.R.C.S., 66, Camberwell road, S.E.
Oct. 28, 1881.	Simons, W. V., Nilgiri house, 5, Baldwin crescent, Camberwell, S.E.
Nov. 23, 1877.	Simpson, T., Fernymere, Castlebar, Ealing, W.
Mar. 20, 1891.	Skipper, W. A., 54, Lombard street, E.C.
Dec. 28, 1866.	Slade, J., F.G.S., Chappel road, Bexley heath, Kent.
Oct. 23, 1868.	Smart, William, 27, Aldgate, E.C.
Dec. 27, 1889.	Smiles, C. L., 15, Bedford row, W.C.
May 25, 1866.	Smith, Alpheus (*Hon. Librarian*), 8, Hanover park, Peckham, S.E.
Mar. 25, 1870.	Smith, F. L., 3, Grecian cottages, Crown hill, Norwood, S.E.
June 27, 1873.	Smith, G. J., F.R.M.S., 6, Malvern road Hornsey, N.
Dec. 16, 1892.	Smith, Richard, 152, Buxton road, Macclesfield.
April 22, 1887.	Smith, T. F., F.R.M.S., 185, Brecknock road, N.W.
Aug. 23, 1872.	Smith, W. S., 30, Loraine road, Holloway, N.
Aug. 22, 1884.	Smithson, T. S., Facit, Rochdale.
Feb. 19, 1892.	Snelling, H., Bacteriological Laboratory, King's College, Strand, W.C.
Jan. 15, 1892.	Soar, C. D., 20, Cortayne road, Hurlingham, S.W.
May 22, 1874.	Spencer, James, F.R.M.S., 121, Lewisham road, Lewisham, S.E.
Sept. 25, 1885.	Spriggs, A. T., Bank of England, E.C.
Mar. 27, 1885.	Squire, P. W., F.L.S., F.C.S., 413, Oxford street, W.
Mar. 22, 1889.	Stephens, T. A., 64, Cavendish road, Brondesbury, N.W.
Dec. 18, 1891.	Stevens, J., 18, Conference street, Christchurch, New Zealand.
April 17, 1891.	Stevens, L., 237, Southwark Bridge road, S.E.
Nov. 27, 1885.	Stevenson, G. T., Glencairn, Castelnau, Barnes, S.W.
Aug. 24, 1866.	Steward, J. H., F.R.M.S., 406, Strand, W.C.

Date of Election.	
June 22, 1877.	STEWART, CHARLES, M.R.C.S., P.L.S., F.R.M.S., etc. (*Vice-President*), Royal College Surgeons, Lincoln's Inn Fields, W.C.
Jan. 25, 1889.	Stocks, H., Guildford street, Chertsey.
June 24, 1881.	Stokes, A. W., F.C.S., 60, Park road, Haverstock hill, N.W.
July 7, 1865.	Suffolk, W. T., F.R.M.S., 143, Beulah hill, Norwood, S.E.
June 24, 1870.	Swain, Ernest, 21, Ladbroke road, Notting hill, W.
Feb. 26, 1886.	Swanson, A. J., 112, Cheapside, E.C.
Dec. 17, 1875.	Swift, M. J., 81, Tottenham court road, W.C.
Jan. 23, 1880.	Symons, W. H., F.I.C., F.R.M.S., 130, Fellowes road, South Hampstead, N.W.
April 17, 1891.	Tabor, C. J., 11, Victoria road, Forest gate, E.
Feb. 25, 1887.	Tait, A. F., 77, Queen street, E.C.
Mar. 18, 1892.	Tallent, J. H., University College, Gower street, W.C.
July 27, 1877.	Tanqueray, A. C., Reid's Brewery, Theobald's road, E.C.
Nov. 28, 1879.	Tasker, J. G., 30, Junction road, Upper Holloway, N.
Feb. 24, 1888.	Taylor, W. W., "The Buttercups," Sutton, Surrey.
Aug. 23, 1878.	Teasdale, Washington, F.R.M.S., Bambrigge road, Headingley, Leeds.
Feb. 24, 1888.	Tebbs, H. V., F.R.M.S., 1, St. John's gardens, Notting hill, W.
Dec. 22, 1865.	Terry, John, F.R.M.S., 8, Hopton road, Coventry park, Streatham, S.W.
Feb. 24, 1871.	Thornthwaite, W. H., 14, Highbury hill, N.
Feb. 17, 1872.	Thorpe, V. Gunson, Surgeon R.N., F.R.M.S., H.M.S. "Peacock," China Station.
June 27, 1884.	Tress, S. C., West lodge, Clapham park, S.W.
July 24, 1868.	Tulk, John A., M.D., F.R.M.S., Cowley house, Chertsey.
June 17, 1892.	Turner, C., Glencoe, Agamemnon road, West Hampstead, N.W.

Date of Election.

July 26, 1867. Turnbull, J., Laurel house, North hill, Highgate, N.

Feb. 25, 1881. Tyler, Charles, F.L.S., F.G.S., F.R.M.S., Elberton, New West end, Finchley road, Hampstead, N.W.

Nov. 18, 1892. Ussher, A. S., the Inland Revenue Department, Somerset House, W.C.

Feb. 27, 1880. Vereker, the Hon. J. G. P., Hamsterley hall, Lintz green, Newcastle-on-Tyne.

May 23, 1879. Vezey, J. J., F.R.M.S. (*Hon. Treasurer*), 55, Lewisham High road, S.E.

June 25, 1880. Waddington, H. J., Moreton lodge, Bethune road, Stamford hill, N.

Mar. 27, 1885. Wainwright, C. J., Elmhurst, East Finchley, N.

July 25, 1873. Walker, J. S., 6, Warwick road, Upper Clapton, E.

May 22, 1868. Waller, J. G., F.S.A., 68, Bolsover street, Portland road, W.

Nov. 22, 1867. Ward, F. H., M.R.C.S., F.R.M.S., Springfield house, near Tooting, S.W.

June 28, 1878. Ward, R. J., Silver street, Lincoln.

Feb. 17, 1893. Ward, W. Cleveland cottage, Hill, Southampton.

April 17, 1891. Waters, J., junr., 41, Bloomsbury square, W.C.

Sept. 28, 1877. Watson, T. P., F.R.M.S., 313, High Holborn, W.C.

Sept. 26, 1884. Watson, W., 313, High Holborn, W.C.

Dec. 16, 1892. Watts, Christopher C., Kensworth, Dunstable, Beds.

July 24, 1874. Webb, C. E., Wildwood lodge, North end, Hampstead, N.W.

Mar. 20, 1891. Webb, J. C., Rutland villa, Henslow road, Dulwich, S.E.

May 24, 1867. Weeks, A. W. G., 36, Gunter grove, West Brompton, S.W.

May 23, 1884. West, C., F.R.M.S., LambtonO ffice, 3, Cross lane, St. Mary at Hill, E.C.

Date of Election.	
April 17, 1891.	West, C., Fernville, Fortis green, N.
May 26, 1882.	Western, G., F.R.M.S., 17, Carmalt gardens, Upper Richmond road, Putney, S.W.
Feb. 25, 1876.	Wheeler, George, 64, Canonbury Park South, N.
Feb. 26, 1886.	White, R., 43, Devonshire street, Islington, N.
Dec. 28, 1888.	Whitehead, C., F.L.S., etc., Barming House, Maidstone, Kent.
Aug. 22, 1879.	Whittell, H. T., M.D., F.R.M.S., Board of Health, Adelaide, South Australia.
June 25, 1880.	Wickes, W. D., F.L.S., 32, Burlington gardens, Acton, W.
Mar. 25, 1881.	Wildy, Arthur, 48, Albion road, South Hampstead, N.W.
Nov. 23, 1877.	Williams, G. S., 20, Oxford road, Kilburn, N.W.
May 22, 1885.	Williams, T., 10, Pitt street, Campden Hill, Kensington, W.
June 27, 1879.	Willson, James, 65, Gloucester crescent, N.W.
Feb. 22, 1867.	Wilson, Frank, 110, Long acre, W.C.
Feb. 19, 1892.	Wright, L., 7, Beaumont road, Hornsey rise, N.
Dec. 16, 1892.	Wynne, George, 28, Nelson square, Blackfriars, S.E.
May 20, 1892.	Young, C., 24, Perham road, West Kensington, W.
Nov. 23, 1888.	Young, G. W., Bridge road, West Battersea.
June 22, 1883.	Young, William Martin, 16, Maclise road, West Kensington park, W.

NOTICE.

Members are requested to give early information to the Editor, or to the Hon. Secretary, of any change of residence, so as to prevent miscarriage of Journals and Circulars.

RULES.

I.—That the Quekett Microscopical Club hold its Meetings at 20, Hanover Square, W., on the third Friday Evening in every month, except July and August, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by a Committee, consisting of a President, four Vice-Presidents, an Honorary Treasurer, one or more Honorary Secretaries, an Honorary Secretary for Foreign Correspondence, an Honorary Reporter, an Honorary Librarian, an Honorary Curator, and twelve other Members—six to form a quorum. That the President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, Curator, and the four senior Members of the Committee (by election) retire annually, but be eligible for re-election. That the Committee may appoint a stipendiary Assistant-Secretary, who shall be subject to its direction.

III.—That at the ordinary Meeting in January nominations be made of Candidates to fill the offices of President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, Curator, and vacancies on the Committee. That the President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, and Curator be nominated by the Committee. That the nominations for Members of Committee be made by the Members on resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That a list of all nominations made as above be printed upon the ballot paper; the nominations for vacancies upon the Committee being arranged in such order as shall be determined by lot, as drawn by the President and Secretary. That at the Annual General Meeting in February all the above Officers be elected by ballot from the Candidates named in the lists, but any Member is at liberty to substitute on his ballot paper any other name or names in lieu of those nominated for the offices of President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, and Curator.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended balloted for at the following Meeting. Three black balls to exclude.

VI.—That the Club include not more than twenty Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscriptions be Ten Shillings, payable in advance on the 1st of January, but that any Member elected in November or December be exempt from subscription until the following January. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid ; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in January.

IX.—That the Annual General Meeting be held on the third Friday in February, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet, duly signed by the Auditors, shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, Reporter, Librarian, Curator, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a Conversazione.

XI.—That any Member may introduce a Visitor at any ordinary Meeting, who shall enter his name with that of the Member by whom he is introduced in a book to be kept for the purpose.

XII.—That no alteration be made in these Rules, except at an Annual General Meeting, or a special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting at which the subject of such alteration is to be considered.

APPENDIX.

Form of Proposal for Membership.

Quekett Microscopical Club.

Mr.

of

being desirous of becoming a Member of this Club, we beg to recommend him for election.

(On my personal knowledge.)

This Certificate was read 18

The Ballot will take place 18

NOTICE TO BINDER.

Page 281 of this number should follow page 280 of the previous number. The List of Members, etc., beginning with "Past Presidents," page 281, and ending page 302 of the previous number should follow the "Proceedings" of the Autumn number of 1894.

Three New Rotifers.

By John Hood, F.R.M.S.

Communicated by C. F. Rousselet, F.R.M.S.

(Read March 17th, 1893.)

Floscularia spinata, n. sp., Pl. XII., Fig. 1.

Specific Characters.—Corona bearing five lobes, broad without knobs; one large dorsal lobe, two smaller ventral lobes, and two very small ones between the dorsal and ventral. The lobes bear long stiff setæ on their summits, and, in addition, short spines stand out from the margin of the coronal cup round its entire circumference, but not very close together.

The last named is a unique character among the Floscules, which distinguishes it at once from all other known forms. In general shape *F. spinata* resembles *F. campanulata* and *F. ambigua*, but is not so widely expanded, and the lobes point more upwards. The foot is long and stout, with a short peduncle. The internal anatomy is that of other Floscules, and does not call for any remarks.

I first found a single specimen in 1886, in a marsh pool near Loch Lundie, on Sphagnum, but could find no more until the spring of 1890, when I obtained a few in a ditch on Tents Muir, and again on Sphagnum from Loch Stormont. It is of large size, measuring $\frac{1}{25}$ to $\frac{1}{20}$in., and is a greedy feeder, living on Infusoria and even small Rotifers. Habitat: Lakes and pools in Scotland.

Polyarthra aptera, n. sp., Pl. XII., Fig. 2.

Specific Characters.—Body a transparent sac without foot; skin very thin and flexible, especially posteriorly; corona transverse; ciliary wreath marginal and single; eye large, single and occipital; mastax large and pear-shaped; trophi forcipate. The corona furnished on dorsal side with two broad, flat, fleshy prominences surmounted by a brush of stiff setæ, and ventrally two long single styles, wide apart. Dorsal antenna situated low down in the middle of the back. Lateral skipping spines wholly wanting.

When I first saw this small Rotifer I was quite at a loss to know where to place it, and several correspondents to whom I sent specimens could not at first decide to what genus it should properly belong. When swimming the creature's motions are not unlike those of a Synchæta, minus the foot and side auricles. It frequently changes its form by muscular contractions of its very flexible skin, and then suggests a Sacculus or small Asplanchna, but then the head and trophi were quite different, and, in addition, it carries its eggs behind, which no Asplanchna or Sacculus does. I also sent some living specimens to Mr. C. Rousselet, who, by the form of the head and trophi, and by its internal organization, recognized it as belonging to the genus Polyarthra, although deprived of lateral appendages. Now the chief character of *Polyarthra platyptera*, so far the only species of this genus, excepting a variety, is its cluster of skipping spines on each side of the body, and it seems absurd at first sight to place beside it an animal wholly deprived of this its principal peculiarity. However, on closer examination, the shape of the head with the two fleshy sense organs, the structure of the jaws, and its whole internal organization is found to be identical with that of *Polyarthra platyptera*, so that no choice is left in the matter, and the specific name of "aptera" appropriately expresses its chief characteristic.

The normal shape of the body is an elongated parallel-sided and flattened sac, squarely truncated in front, but more rounded and creased behind; but this shape is frequently altered by the contractions of a broad band of muscular threads encircling the body just below the head, which can contract the body into a more or less dumb-bell shape, as represented in Fig. 2a. The skin also is so thin and flexible posteriorly that it is frequently thrown into folds of various shapes. In *P. platyptera* the skin is firmer and the shape more constant.

Two pairs of flat muscles are attached to the head and posteriorly to the skin, but the prominent striated muscles of *P. platyptera*, which actuate the blades, are here quite absent. The large spherical and nearly black eye is seated on the small brain. The trophi are forcipate like those of *P. platyptera* and are shown in Fig. 2b. from Mr. Rousselet's sketch. The stomach and intestine, as well as the lateral canals and tags, are normal. The ovary is large and generally bulges out ventrally. The eggs are carried attached to the posterior, both female and

ephippial eggs being carried singly, and male eggs in clusters of four to six, but I have not yet been able to see the male.

A dorsal antenna, consisting of a small pit furnished with stiff setæ, is situated low down near the centre of the dorsal side; the lateral antennæ could not be found in the posterio-lateral angles, and in both these particulars the animal differs from *P. platyptera*.

A fairly large contractile vesicle is obvious in the posterior part of the body cavity. I first found a few examples of *P. aptera* in the spring of 1892 in water from Loch Lintrathen, Forfarshire, and again in large numbers in March of this year, associated with *Synchæta longipes*, *S. tremula*, *Polyarthra platyptera*, *Notops pygmæus*, *Conochilus unicornis*, *Anuræa aculeata*, *cochlearis* and *brevispina*, *Notholca longispina*, and very few examples of the very peculiar Rotifer lately described by Wierzejski and Zacharias under the name of *Bipalpus vesiculosus*. Size of female $\frac{1}{250}$ to $\frac{1}{200}$in. Habitat: Lakes in Scotland.

Brachionus tridens, n. sp., Pl. XII., Fig. 3.

Specific Characters.—Occipital spines three, lorica thin, smooth, transparent as in *B. pala*. Posterior spines absent. Marine.

The chief peculiarity of this new marine Brachionus consists in having only three spines on the occipital edge of the lorica, one of which is median. In other respects the lorica resembles that of *B. pala*, but without posterior spines.

I found this Rotifer sparingly already in 1885 in the Tay, associated with *B. Mülleri*, *Pterodina clypeata*, *Notholca thalassia*, *Colurus dicentrus*, *Mytilia tavina*, and have never met with more than five or six specimens. The corona is more like that of *B. urceolaris*, but in all other respects the anatomy resembles that of *B. pala*. Foot long and wrinkled. Size of lorica $\frac{1}{90}$in. Habitat: Salt and brackish water. Scotland.

EXPLANATION OF PLATE XII.

Fig. 1. *Floscularia spinata*.
,, 2. *Polyarthra aptera*. Dorsal side.
,, 2*a*. Ditto. Contracted shape.
,, 2*b*. Ditto. Jaws.
,, 3. *Brachionus tridens*.
,, 4. *Rattulus bicornis*. Jaws.

On a New Species of Metopidia.

By David Bryce.

(*Read April 21st, 1893*).

This new form has occurred in moderate numbers in a "stock" jar containing a recent gathering of moss found growing and partly immersed in running water in Epping Forest. As, however, its presence in the moss gathered was probably fortuitous, I do not regard it as an addition to the moss fauna.

Metopidia parvula, n. sp.

Sp. Ch. Of minute size. Lorica ovate, much elevated, the back rounded, the edges somewhat overhanging; hind margin rounded, ventral surface flat, foot and toes of unusual proportions, the latter slender, acute and slightly flexible.

As compared with *M. pygmæa*, which Mr. Gosse described from a single Irish specimen, and whose occurrence has not, I think, been again recorded, the most striking difference is in the form of the toes, which in my specimens were very similar to those of other species of the genus, whereas *pygmæa* is stated to possess a "toe apparently single, small, acute." The total length in each case being about the same, the new species is apparently of much smaller bulk, as in it the toe accounts for quite one-fourth of the total; and, further, although the lorica is strongly arched, it is not so much so as shown in Mr. Gosse's figure. The lorica alone measured as nearly as possible $\frac{1}{500}$th of an inch in length, the greatest breadth being as 13 to 16. In shape it is ovate, broadly excised in front, and rounded behind. In young specimens the slightly overhanging margins of the dorsal plate are a little turned inwards underneath, and there is a distinct pinching in of the sides, at about the level of the foot, producing an apparent obtuse pointing of the central posterior margin. This disappears in older individuals, and the hinder margin is seen to be entire and evenly rounded off,

whilst a suggestion of the pinching in remains in a faint sinuation of the lateral margins. The ventral plate, which is excavate anteriorly in a moderate curve, appears almost membranous behind, and I could with much difficulty distinguish lines marking a wedge-shaped foot orifice. The creature possesses the usual hyaline somewhat pointed hood, and to right and to left of its base I could see the opaque particles frequently present in *Metopidiæ*, and below these, again, the two pale red eyes. The mastax and the internal organs were fairly distinct, but with one exception suggested no remarks. The contractile vesicle was unusually large and extended like a narrow sac from side to side, just above the base of the foot, being best seen from the ventral side.

Length ... ... $\frac{1}{350}$ inch, extended.
Habitat ... ... Epping Forest.

On the Resolution of A. pellucida and a Violet Copper-Iodine Light Filter.

By Prof. Zettnow, of Berlin.

(Communicated by G. C. Karop, May 19th, 1893.)

Of all microscopic test-objects *A. pellucida* is by far the most difficult: whilst *Van Heurckia crassinervis* and *Surirella gemma* can be shown completely resolved with good objectives and central, or but slightly oblique illumination and daylight, the same glasses under the same conditions only give the mere outlines of Amphipleura, and only then provided the diatom is mounted in realgar with a high refractive index of 2·4.

One only succeeds in rendering the transverse striæ visible even with strongly oblique illumination, whilst the much more delicate and closer longitudinal lines demand the most extremely oblique light, and, therefore, small aperture, so that numerous and well-marked diffraction lines are unavoidable.

By using instead of white light the dark-blue, transmitted by cupric-ammonia solution, the resolution becomes easier, as an objective of certain aperture is capable of resolving even finer series of lines as the wave length of the light employed is shortened, and hence the employment of a blue light filter in photographing diatoms. The numerical aperture of an apochromatic of 1·4 in daylight rises to 1·65 if dark-blue light is used. Following this train of thought, I endeavoured to increase the performance of a Zeiss apo. of 1·4 N.A. by employing a violet filter, which permitted the use of rays of lesser wave length than a dark-blue, not merely to resolve the transverse and longitudinal striæ of the Amphipleura, each with its own most favourable illumination, but to photograph them both at the same time; in other words, to get the Amphipleura resolved into beads such as are exhibited by the easier test-objects. The diffraction lines, which when they

show up vividly destroy any kind of picture, must be entirely eliminated, or show in a slight, non-interfering degree only.

After spectroscopic trial of a large number of violet fluids, the best filter proved to be a solution of iodine in chloroform; this of a suitable concentration only permits the transmission of red and violet rays, so that by absorption of the former by a cupric-ammonia filter one can make use of violet light only.

If the solution contains a half per cent. of iodine, a layer 6 mm. thick allows of working with rays from G to H alone, directly the red rays are absorbed by a cupric-ammonia filter of such a concentration as to pass rays from F onwards.

For this copper-iodine filter, therefore, two cuvettes (containers) are required, as, firstly, the active substances are not chemically indifferent as in the copper-chromate filter, and, secondly, the fluids will not mix together.

As the eye is but slightly sensitive to violet rays, the field of vision is much darkened; even with bright sunshine this loss of light is disagreeably felt. Realgar mounts are inadmissible, as the yellow colour of this substance completely absorbs the violet rays. In taking the Amphipleura reproduced in phototype in Fig. 858 × 6,400,* therefore, I used a preparation by J. D. Möller mounted in iodide of mercury; the illumination was as much as possible oblique, and the aperture so small that strongly marked diffraction lines made their appearance. The impression was taken on a slow erythrosin plate covered with No. 140 of my emulsion, and for strengthening the contrast the negative was first treated with silver and gallic acid, and then intensified with mercury and sulphate of ammonia; it was only in this wise possible to properly reproduce on the plate the complete resolution of the diatom as seen by the eye by the contrast of light and shade. Avoidance of the diffraction by using a larger aperture was impossible, as the delineation became too pale for photographic impression (apochromatic N.A. 1·4 Zeiss).

The proximate conditions under which the negatives for Figs. 779, 788,* and 791 were produced are as follows:—In all an aperture of $\frac{1}{5}$-$\frac{1}{6}$=0·3-0·25 of the apochromatic was employed, the illumination as oblique as possible; the cupric-ammonia filter tested by sunlight passed rays from about

* The figures refer to the original paper published in Eder's "Jahrbuch f. Photogr. u Reproductionstechnik," f. 1893.

λ. 505 onwards, but of those valid on the plate only from λ. 505-440, as the violet were completely absorbed by the realgar: in Figs. 788 and 791 a slow erythrosin plate, No. 140 of my emulsion, was employed, and the negative was not intensified. The exposures in bright sunlight lasted two and eight minutes, and would have taken about thirty minutes for the 6,000 diameter picture, obtained with compensating ocular 8, and, therefore, for this latter, Fig. 779, an ordinary, highly-sensitive, rapid plate, No. 142 of my emulsion, was employed, and exposed for four minutes. As such plates are much more delicate than the less sensitive erythrosin ones, this accounts for the weak character of the impression. Development with pyro-gallol soda. According to my repeated measurements, in which the magnification was exactly estimated, the transverse striæ of Amphipleura in the middle are 4,100 and the longitudinal 5,200 per mm.

[NOTE.—1st. The exhibition of two sets of striæ at right angles to one another is not a proper resolution of the *A. Pellucida*, neither are beads formed by the intersection of such striæ the proper resolution of the coarser diatoms.

2ndly. The resolution of striæ and beads is no test of quality, it only affords a rough measure of the aperture of an objective. —ED. "Q.M.C. Journal."]

A Further Note on "Optical Tube Length."

By A. Ashe.

(Read May 19th, 1893.)

In the last number of our Journal there is a brief account of a new method of estimating the optical tube length of a microscope.

You may recollect that the method described is based upon the increase in power obtained by withdrawing the eye-piece through some known distance.

It is, however, quite possible to dispense with the measurement of the power in two positions, and thus to simplify the determination, as well as to economize time, which to many persons is a matter of considerable practical importance. The following details will perhaps render the matter clear:—

Instead of measuring the power of the microscope twice over it is sufficient to place a micrometer or other divided scale on the stage and count the number of lines that fill the field of view from side to side, then to pull out the draw-tube some inches and repeat the counting.

Of course the greater the increase in power the fewer will be the number of lines seen. In other words, the number of lines and the magnifying power are in inverse proportion to each other.

Now, for the purpose in view, it does not matter one iota what the actual powers of the instrument may be, with its draw-tube in various positions, so long as we know the proportion those powers bear to each other, and this proportion we shall find in the relative number of lines which fill the field of view at the same points.

Hence (bearing in mind the inversion of the ratio) we may look upon the number of lines counted as though they were the actual powers of the microscope, and proceed at once to apply the formula mentioned in the other paper, thus saving a deal

of time and also obtaining results which correspond precisely with those given by the other and more lengthy process.

An example may be useful —

Magnifying power with the tube closed... ... ... = 100
" " " extended three inches = 150

Increase ... ... = 50

Therefore ... ... $\frac{100 \times 3}{50} = 6$ (inches) tube length.

Again, by the shorter way —

Number of lines that fill the field with the tube closed... = 30
Number of lines that fill the field with the tube extended three inches ... ... = 20

Increase ... ... = 10

Therefore inverting these $\frac{20 \times 3}{10} = 6$ (inches) tube length.

On the Antheridia, etc., of some Florideæ.

By T. H. Buffham, A.L.S.

(*Read June 16th, 1893.*)

Plates XIII., XIV.

In a paper on this subject, read in October, 1890 (*Journal*, vol. iv, ser. ii, p. 246), after descriptions of the antheridia of certain Florideæ, I briefly mentioned by name only others that were collected in August, 1890. The following notes include the latter together with others acquired since. With two exceptions (which are indicated in the proper place) I have drawn none which have been figured before, but to render the record for this country more complete some others are included although described abroad. Unless otherwise indicated the specimens were collected by myself, but I have to acknowledge my indebtedness to Mr. J. T. Neeve, of Deal, for several of the most interesting species. He has intelligently followed my suggestions, and furnished me, for study, with small collections at seasons when I could not visit the shores for the purpose. Where the present names differ from those in Harvey's *Phycologia Britannica* the latter are placed in parentheses. Specimens have generally been preserved in a saturated solution of sodium chloride, but sometimes in glycerine.

This and the next alga are remarkable parasites. The present one—*Choreocolax Polysiphoniæ* Reinsch. (not in *Phyc. Brit.*) —is found on *Polysiphonia fastigiata* Grev. The endophytic portion consists only of a few slender filaments whereas the external portion is wholly devoted to the development of reproductive organs. The antheridia are single or in groups of several, each antheridium being globose or sub-reniform, about ·5 mm. in diam. It may be distinguished by the circumstance that the surface is dark, with numerous bright circular spots, about 12 μ in diam., and in these a few dots appear (Plate XIII., Fig. 1). A vertical section shows that the pollinoidigenous cells

form a bunch of incurving short threads arising from a base of branching cells. The bunch is below a portion of the exterior where the general surface is not indurated, but consists only of the gelatinous investment usual in antheridial layers. Indeed, the bright spots just mentioned as on the surface are over this bunch. Between these bunches are longer filaments forming a kind of involucre (Fig. 2). The male organs of this alga do not appear to have been observed before, although the cystocarps and tetraspores have been described and drawn by Mr. H. M. Richards (*Proc. American Acad. of Arts and Sciences*, vol. xxvi.), and I found them very rare in a quantity of *Poly. fastigiata* infested. (Folkestone, June, 1892, collected by Mr. J. T. Neeve.)

Harveyella mirabilis Schmitz et Rke. (*Choreocolax mirabilis* Reinsch. Not in *Phyc. Brit.*)—This parasite is usually much more conspicuous than the preceding, and is found on *Rhodomela subfusca* Ag. The male plant forms a group of two to eight rounded lobes, each ·3-·5 mm. in diam. It may be distinguished from those bearing other organs (Pl. XIV., Figs. 40, 41) by its uniformly brown colour surrounded by a semi-translucent yellowish border (Pl. XIII., Fig. 3). A vertical section shows the body of the lobe to be composed of irregularly-rounded cells set in a considerable mass of hyaline substance. A short distance below the surface numerous smaller cells appear, and from these arise tubes about 10 μ wide, and the pollinoids are seen in these in single or double rows of four to six in length and are emitted from the mouth of the tube at the surface (Fig. 4.) The process appears to be continued by the repeated formation of pollinoids from the lower brown cells, so that a considerable number will be produced from a superficial area of this small size. There are cases in which a similar mode of production exists to a limited extent, but I am not aware of any at all approaching the productive power of this interesting parasitic alga. These organs have been recorded only on the German coast by Schmitz and Reinke. (Deal, February, 1892, collected by Mr. Neeve.)

Phyllophora rubens Grev., a membranous plant of very unattractive aspect to the mere collector, produces antheridia of even elaborate structure. These are subspherical bodies on a thin pedicel, borne at, or just within, the borders of the upper

portions of the thallus. They are white, ·6-·8 mm. in diam., and visible to the unassisted eye (Fig. 5). The surface view shows the exterior of this minute ball to be made up of groups of more or less circular spaces from which the inner arcs are absent, and thus there are formed areas of roughly elliptical outline. From the sides of these tufts of minute filaments spring which produce at their extremities the pollinoids (Fig. 6). A vertical section shows that one of these areas is but the exterior view of a cavity which has a depth down to 200 μ, with a width of 50-80 μ. Moreover its depth also appears to be made up of a number of cavities that are segments of hollow spheres, and from each of these also spring tufts of filaments like those seen near the surface (Fig. 7). (Deal, September, 1891, collected by Mr. Neeve. Also by Mr. E. A. Batters, at Berwick, October, 1889.) In my previous paper (*loc. cit.*) there are figures (Pl. XVI) of the antheridia of *Ph. membranifolia* J. Ag., and it will be obvious that they differ enormously from those of *Ph. rubens.* I venture to think this would justify the resumption of Kützing's name for the former—*Phyllotylus membranifolius.* The antheridia of *Phyllophora rubens* have been incidentally mentioned by Thuret and Bornet in their *Études Phycologiques*, p. 82.

Cystoclonium purpurascens Kütz. (*Hypnæ purpurascens* Harv.)—In this filamentous plant a careful examination with the microscope will only show on some of the uppermost ramuli a surface with a rather less vivid colour, and a very narrow hyaline border projecting a little. A transverse section shows the cells just below the ordinary cells dividing vertically and these producing the pollinoidiferous cells surmounted by a gelatinous arch. Amongst these are some unchanged cortical cells (Fig. 8). (Swanage, August, 1890.)

In my last paper (p. 251) I mentioned *Rhodophyllis appendiculata* J. Ag. I then thought I had the antheridia, but I now consider this doubtful.

Sphærococcus coronopifolius Stackh.—On this species, copiously furnished with cystocarps, I had long noticed, on the surface of the compressed thallus, numerous minute spots, more lucid than the ordinary cortical cells, without ascertaining their true nature. They are most numerous at some little distance below the apices of the plant. Collecting some specimens (Wey-

mouth, August, 1890) in fresh condition I noticed that the clearer spots, about 20 μ in diam., were rather larger than the ordinary cortical cells, and in some cases two or three were together. In these were observed minute dots, and below these a larger body (Fig. 9). A section shows the usual structure of a simple antheridium in which a basal cell produces four smaller cells above it, and these may, either at once or by again dividing vertically, produce the elongated bodies that actually put forth the pollinoids. As the last-named corpuscles were seen emerging from the gelatinous covering (Fig. 10) I think there can be no doubt that these are the male organs of this plant.

In *Gracilaria confervoides* Grev. I found the male plants were small, and beset with numerous short, thin branchlets. The antheridia appear on the surface as circular white spots from 20 μ in diam., or elliptical up to 100 μ in major axis by 50 μ in the minor, very numerous, and readily visible with a low power (Fig. 11). They are oldest at a short distance from the base, and very small and immature in the upper portions of the principal filaments. With a higher power it will be seen that this spot is but the thin roof of a cavity, with a delicate ring at the vertex indicating the opening through which the pollinoids are emitted, the sides and bottom of the cavity being uniformly covered with the cells which produce them (Fig. 12). A transverse section of the filament through a cavity shows an ovate or flasked shape, the neck opening on to the surface of the filament. Exquisite figures of this aspect have been given by Thuret and Bornet in *Études Phycologiques*, Pl. 40. (Teignmouth, August, 1892.)

The antheridia of *Rhodymenia palmata* Grev. were figured by Thuret nearly 40 years ago (*Ann. des Sci. Nat.*, 4me Ser., T. 3, Pl. 3) as forming a layer in irregular spots on both sides of the plant. Mr. E. A. Batters collected a male specimen at Berwick, March, 1889. I found several plants (Swanage, etc., June, 1892) in this condition, and noted that they were small, cuneate, generally trifid, about 8 cm. (3 inches) in height, and mottled from near the base to halfway to the upper end by paler spots. But even on a surface view these have a very different appearance from the antheridial layer of any other membranous alga. It will be convenient to compare them throughout with those of *Rh. Palmetta* Grev., a small specimen

of which I received from Mr. Neeve (Deal, Aug. 1892). In the latter plant the antheridial layer nearly covers a small portion of the apices of the thallus (Fig. 15), but viewed from above the layer appears as small dots set, with spaces between, in a hyaline ground (Fig. 16); whereas in *Rh. palmata* the appearance is a dingy greenish patch in which there are no clear spaces, but the cells are as closely crowded as possible (Fig. 13). Sections show even a greater difference. In *Rh. Palmetta* we have the elongated cells which produce the pollinoids set in a considerable gelatinous investment through which the pollinoids themselves (2-2·5 μ in diam.) can be seen to make their exit (Fig. 17); whilst in *Rh. palmata* we find the elongated cell surmounted by a larger ellipsoidal body of very delicate appearance (4·5 μ in diam.) which appears to be a cell with a very thin wall, but I have not been able to satisfy myself that its contents issue in the form and substance of a pollinoid. It will be noted (Fig. 14) that there is no trace of the gelatinous covering so conspicuous in *Rh. Palmetta*, and in all similar antheridial layers known to me. Now it is remarkable that no cystocarps have ever been seen on *Rh. palmata*. I cannot but think it probable that these curious patches of so-called antheridia have no fecundating corpuscles, and they may, indeed, be a case of degradation from progenitors possessing the necessary capacities.

In a former paper (*Journal*, vol. iii, ser. ii, p. 261) I briefly described the antheridia of *Chylocladia articulata* Grev., now more correctly named *Lomentaria articulata* Lyngb. Having since then (Sidmouth, Aug., 1891) found a larger specimen I have obtained transverse sections of the filament through the antheridial layer. These show the considerable amount of the gelatinous investment of every part of the altered cortical cells concerned in the production of the pollinoids (Fig. 18).

The antheridia of *Nitophyllum Gmelini* Grev. I have found not only in elongated patches near the margin of the plant but also in minute narrow processes springing from the margin. These are generally in pairs (Fig. 19), and frequently are bifid, the antheridial spots being arranged bilaterally with a clear line of unchanged cells separating them. The last feature is readily seen in the transverse section, where also it can be noted that both faces of the thallus are similar (Fig. 20). The

thickness of the membranous frond itself is about 40 μ. Where the antheridial layers occur the total thickness is then about 85 μ, of which each layer occupies about 30 μ, and the middle line of cells is then reduced to 25 μ. The male cells are closely set and well covered with the usual gelatinous accompaniment (Fig. 21). (Swanage, Aug. 1890.)

The genus *Delesseria* undoubtedly stands near to *Nitophyllum*, and we naturally find a resemblance in their antheridia. In *D. alata* Lamour. the male organs are found in minute leaflets arising from the apices of the plant, and, especially, in groups from the axils. These leaflets are about 1 mm. long by ·5-·7 wide (Fig. 22). A transverse section shows layers to practically cover both surfaces (Fig. 23). The gelatinous covering is not so great (Fig. 24) as in the preceding species. (First detected by me on a dried specimen collected by Mr. Neeve at Deal, Nov. 1883, and sent me in 1890. Figures are drawn from a fresh specimen collected also at Deal, Nov. 1891. Mr. Batters found it at Berwick, Oct. 1889.)

In *D. ruscifolia* Lamour. the antheridia are found on all the leaflets of the plant, and to the naked eye appear as interrupted lines lying each side of the midrib. A low power suffices to show that the general longitudinal arrangement is made up of minute irregular spots which are frequently elongated obliquely by extending between the lateral veins (Fig. 25). Here a transverse section of a leaflet through the lamina bearing two spots on each face gives very irregular outlines of the exterior of the spots, with a thickness through all of about 70 μ (Fig. 26). The male cells are much slenderer (Fig. 27) than those of the preceding species. (Swanage, Aug. 1890.)

The most conspicuous antheridia known to me are those of *Hydrolapathum sanguineum* Stackh. (*Delesseria sanguinea* Lamour.) Like the cystocarps and leaflets bearing the tetraspores the male leaflets spring from the midrib of the "leaves" when the beautiful lamina has nearly disappeared, leaving only defaced and ragged remnants. A tuft of the natural size is shown in Fig. 28. Some leaflets reach a length of 6 mm. They are white, and are covered on both sides—with the exception of a border of a few cells wide—by a uniform layer of gelatine in which the male cells are set (Fig. 29). The leaflet is thickened along the middle as seen in a transverse section.

The male cells approach the surface of the gelatine more nearly than in *Delesseria*, and that surface assumes a much more regular level (Fig. 30). (Deal, Oct. 1891, by Mr. Neeve. Previously collected at Berwick by Mr. E. A. Batters, Nov. 1889.)

Bonnemaisonia asparagoides Ag., one of our rarer algæ, is also very beautiful when fresh, but it seems impossible to preserve this delicate plant without considerable change in the contents of the cells of the thallus. But with regard to the antheridia the condition is very well maintained in a saturated solution of sodium chloride. I have not met with plants wholly male, but was fortunate in taking a considerable number where everyone had those organs on the upper portions, while the lower portions bore cystocarps. (Swanage, Aug. 1890.) The antheridia, like the cystocarps, are always opposite to a ramulus, and frequently alternate with a procarp. Dr. Bornet states that on the monœcious plants the antheridia are smaller than on the plants wholly male. In my specimens they reached 100 μ in height, with a maximum thickness of 60 μ. They are obovoid, but generally unsymmetrical, white, with a central axis of small cells. The elongated male cells surround this axis in a uniform thickness. The figure of Derbès and Solier (*Mémoire sur quelques points de la physiologie des algues*) does not exhibit this character very well; I have therefore attempted to do so (Fig. 31).

By the kindness of Mr. E. A. Batters I am enabled to add to these notes a description of the antheridia of *Odonthalia dentata* Lyngb. They occupy similar positions to those of the cystocarps and tetraspores, and consist of tufts of paler leaflets near the axils. The leaflets are 2-3 mm. long by 1-1·2 wide, and are thus visible to the unassisted eye (Fig. 32). Their form is ovate, sometimes inequilateral, frequently bifid (Fig. 33); and they are uniformly covered on both faces by the antheridial layer, excepting on a narrow margin (Fig. 34). A transverse section shows the leaflet thickened along the middle (Fig. 35); and the brownish, rather stout, male cells, which emit the pollinoids, rise nearly to the surface, having only a thin gelatinous covering (Fig. 36). Kützing briefly mentions the leaf-like "spermatoidia" [antheridia] in *Phycologia generalis*, p. 109 (1843); and again in *Species Algarum*, p. 846; but I know of

no other record, nor are any figures extant. Mr. Batters' discovery at Berwick in Nov. 1889 was quite independent as these remarks of Kützing's had escaped his notice. This is a striking instance of the necessity of searching for antheridia where they are insufficiently known.

Laurencia obtusa Lamour.—The ultimate branchlets of the male plant are curiously wrinkled with sinuous transverse ridges. The antheridia are formed in the cuplike hollow at the apex of each branchlet, but it is necessary to dissect them out. It is then seen that the hollow contains 10 or 12 dense masses of male cells. Each has a peduncle which branches out on all sides, and this is repeated at such short intervals that there results an almost globular mass, 120-150 μ in diam. The youngest and smallest masses are in the centre of the hollow, and the oldest and largest bulge out at the top. Some of them have branching filaments projecting above the mass. The pollinoids are spherical, 6 μ in diam. (larger than any described above), and are discharged from ellipsoidal cells a little larger. (Swanage, Aug. 1890.) Harvey appears to have seen the antheridia of this species (see remarks in *Phyc. Brit.*), and Derbès and Solier have figured them (*op. cit.*) but not very completely.

Polysiphonia urceolata Grev.—I found a few antheridia on some tetrasporic plants. The male organs were near the apices; the tetraspores lower down. The antheridia in this species are mucronate, and of the character usual in this genus. (Teignmouth, Aug. 1892.)

In *P. Brodiæi* Grev. the antheridia are tapering, but not mucronate, nor very obtuse. They are copiously borne at the apices of the filaments. (Swanage, Aug. 1890.)

Spermothamnion hermaphroditum Näg. has been frequently described and figured after him in botanical textbooks. Almost invariably a short ramulus bearing a procarp with trichogyne is accompanied by a single antheridium terminal on a unicellular ramulus. The male body after maturity falls off entirely. Although sometimes regarded as a variety of *Sp. Turneri* Aresch. (*Callithamnion Turneri* Ag.) I am inclined to think it specifically different. The cystocarps are frequently almost naked; the antheridium seems to have a looser texture than in *Sp. Turneri*; the tetraspores are generally single or

two together; the chromatophores appear to be smaller; the contents of the cells do not shrink so much. In any case the condition is an interesting one. I may add that in some specimens in which tretraspores predominated there were a few procarps. (A small specimen with procarps, trichogynes, cystocarps and antheridia, Llanduduo, July, 1886, collected by a non-algological friend. The others by myself at Swanage, Aug. 1890.)

Halarachnion ligulatum Kütz. (*Halymenia ligulata* Ag.)—I long searched unsuccessfully for the antheridia in this species until I found a plant (Swanage, Aug. 1890) which had many very thin ramuli, from ·7 mm. to a fine point (Fig. 37), and, especially, on the middle portions of these I detected, amongst the ordinary superficial cells, a few differing from these by having a few dots above a spot in the centre lower down. They occur singly, or in couples, rarely many more, each single antheridium being about 15 μ in diam. (Fig. 38.) They are very difficult to detect, especially when fresh. Much patience is required to secure a section through them. However, this exhibits a cell which produces four male cells above, and these emit the pollinoids which are minute. The gelatinous covering rises but slightly above the general surface (Fig. 39).

In *Polyides rotundus* Grev. the arrangement differs from that of all other algæ. On the stout filaments of the plant a yellowish long patch near the apex can be seen by the naked eye, projecting, but only some ·2 mm. A transverse section of the filament is a vertical section of the antheridial patch, and shows the latter to consist of closely set, erect, colourless filaments of 6 to 10 elongated cells which reach a height of 150-200 μ. Out of the filaments, especially the upper portions, bud out numerous male cells, the whole forming a kind of spike. Each cell, with a thick but perfectly hyaline wall, contains a pollinoid, which is readily distinguished as it is slightly granulated, spherical, and of large size, about 6 μ in diam. The antheridia of this species are described by Thuret, and figured in *Études Phycol.*, p. 76, Pl. 37. (Margate, Aug. 1891, by Mr. Neeve. Cumbrae, same month, by Mr. Batters.)

Choreonema Thureti Schmitz was demonstrated by Bornet (who named it *Melobesia Thureti*) to be a parasite of various Corallinaceous algæ (*Études Phycol.*, p. 97). Harvey had sup-

posed it to be an abnormal form of conceptacle of *Corallina squamata* Ellis, as those he examined contained zonate tetraspores. Like several other parasites it belongs to the same order as its hosts. The male and other conceptacles are much smaller than those of the hosts. I found all three kinds of organs of this parasite on *Corallina rubens* Ellis et Sol. (*Jania rubens* Lamour.) (Swanage, Aug. 1890.) For figures see *Études*, Pl. 50.

To turn now to the corresponding early stage of the female organs I may say that procarps with trichogynes have been observed on the following species. In most cases pollinoids affixed to the trichogynes have also been seen.

Choreocolax Polysiphoniæ Reinsch.—The procarp has many long stout trichogynes, and frequently they bend at a right angle and for the greater part of their length lie parallel with the surface.

Harveyella mirabilis Schmitz et Rke.—In this also the trichogynes are long and thick, and possibly even more numerous than in the preceding.

Chondrus crispus Stackh.—In a specimen where the upper portions of the thallus became much divided were clearer spots, very numerous and close together, with yellowish bodies below the surface. As these seemed like the work of an animal parasite a portion was sent to Miss Ethel S. Barton, who, after examination, thought the cells resembled "young procarpia more nearly than anything else." Subsequently, in a section, a short pale trichogyne could be traced to a group of the yellowish cells, two large, four smaller, two of the latter lying nearer to the surface of the thallus.

Rhodophyllis appendiculata J. Ag. (*Rhodymenia bifida* Grev., *β ciliata*.)—The procarps are in very minute processes; the trichogyne is long and slender.

Bonnemaisonia asparagoides Ag.—The transparency of the procarp permits the trichogyne to be followed in its spiral way to the exterior.

Laurencia hybrida Lenorm. (*L. cæspitosa* Lamour.)—In the apical depressions.

Polysiphonia violacea Grev.

Spermothamnion hermaphroditum Näg. has already been mentioned.

Antithamnion plumula Thur. (*Callithamnion plumula* Lyngb.) —Long, thin, flexuous trichogyne.

Halarachnion ligulatum Kütz. (*Halymenia ligulata* Ag.)

Polyides rotundus Grev. With fecundating tubes.

Corallina officinalis L.

C. rubens Ellis et Sol. (*Jania rubens* Lamour.)

I have said *supra* that the external portions of the parasitic alga *Choreocolax Polysiphoniæ* are devoted to the production of the reproductive organs. Cystocarps may be distinguished from the others by the surface showing large brown cells through a brown epiderm. Usually an ovoid, lobed form of ·5-·7 mm. in length comprises several cystocarps, and each has a conspicuous ostiole about 30 μ in diam. Sections show a remarkable structure differing considerably from that of any other British alga. Mr. Richards (*loc. cit.*) has very fully described and figured American specimens. The carpospores line the whole of a deep ovoid cavity. I do not, however, see them quite as he draws them. Instead of the spores being of a nearly uniform size and regularly placed, while each is accompanied by a slender paraphysis of the same height, my sections show, at regular intervals, groups of spores in different stages of maturity, with very few slender bodies that may be barren threads. The tetrasporic specimens—of a similar size, but globose—exhibit a surface in which the apices of the cells are loosely set in gelatine with the tetraspores interspersed. They resemble tetrasporic specimens of *Harveyella mirabilis* (Fig. 41). In a section the tetraspores of *Ch. Polysiphoniæ* are found to be elongated, and cruciately divided. (Folkestone, June 1892, collected by Mr. Neeve).

The female specimens of *H. mirabilis* usually consist of groups of globose or ellipsoidal cystocarps, each about 1 mm. in diam., which may be distinguished with a low power as the greater part of a cystocarp is dark within. This is surrounded by a concentric light zone, and this again by another less light just within the surface (Fig. 40). In a vertical section we observe another instance of structure differing from that of all

other cystocarps found here. The solid mass of large cells is covered by a dense thicket of slender filaments which bear spores at their apices. The spores are ellipsoidal, 17 by 13 μ. The pericarp is of considerable thickness and the sporiferous central moss is connected with it by numerous threads. The spores appear to issue by several passages and not by one common ostiole. The tetrasporic balls sometimes reach a diam. of 1·3 mm., and, having no epiderm, they are much lighter in appearance (Fig. 41), and readily show the superficial cells and the tetraspores placed amongst them in profusion. Even small specimens produce them. The body of the ball is made up of irregular cells with very wide hyaline walls. Approaching the surface the cells are much smaller and more crowded. Above these are elongated cells which develop into sporangia with a gelatinous exterior. The tetraspores are 25-45 μ long by 17-20 μ thick, of roughly obovoid form, rather irregularly cruciate (Fig. 42). I believe these have not previously been found. (Deal, July, 1891, collected by Mr. Neeve.)

Ahnfeldtia plicata J. Ag. (*Gymnogongrus plicatus* Kütz.) is an alga which has puzzled most students, for although it bears wart-like bodies having a radiating structure nothing more has been ascertained. Receiving from Mr. Neeve (Deal, March 1891) some specimens in which the nemathecia had a zone more purplish than usual I again cut sections. In some of these I observed some ellipsoidal bodies escaping, about 15 μ long, and 7 μ thick. Close scrutiny under a $\frac{1}{8}$-inch Zeiss wet immersion objective, and a magnification of 1200, showed a granular structure but no indication of division. These bodies are formed at the extremity of a filament of several elongated cells below which are smaller and shorter cells, and the uppermost (at any rate) are contained in a tube which opens at the surface of the nemathecium (Fig. 43). There is always a clear space between the bodies and the extremity of the tube, and the wall here shows a delicate striation or wrinkling (Fig. 44). I have examined small young, and larger old, nemathecia with the same results. The structure throughout is alike. It is evident then that the bodies are continuously being formed by the development of the lower cells. Dr. Bornet, to whom I imparted my conclusions, sent me a copy of a note he had made at Cherbourg as long ago as 1857: "Dans l'*Ahnfeldtia plicata* J. Ag.

les articles superieures des filaments articulés dont sont composés les tubercules se transforment en spores. Chaque article laisse échapper une spore globulense assez petite." My results agree precisely with this note with the exception of the form, but as my specimens were not living the spore did not assume the globose form on becoming freed. It has been suggested that these bodies are pollinoids. But the usual course in the production of pollinoids is here reversed; for, instead of the repeated division of cells into, finally, the *smallest* bodies, we have in *Ahnfeldtia* the final body *larger* than the cell from which it is developed. The size, moreover—though very small—is many times that of the largest pollinoid known. The spore is, in all probability, an asexual organ.

The cystocarps (favellæ) of *Plumaria elegans* Schmitz (*Ptilota sericea* Harv.) are usually described as "naked or involucrate," and the tetraspores as "sometimes polysporic." From a study of fresh specimens (collected by Mr. Neeve at the S. Foreland, Dec. 1892) I have been led to the conclusion that there has been some confusion in these descriptions. The organs studied are certainly the same as those figured by Pringsheim (*Beiträge zu Morphologie der Meeres-Algen*, 1862, Taf. 8). His description of the figure is: "Ast mit nackten Favellen." There is, however, in the recent specimen no trichogyne nor procarp. Although the contents of the sporangium in an early stage are divided into four it can readily be distinguished from a true tetrasporangium as the manner of division is rather cruciate than tripartite, and the colour is paler. These sporangia continue to enlarge, and the segments to divide, until at maturity there are 16 spores, irregularly ovoid, 45-48 μ in length, and possessing a cell wall even before discharge. Prof. W. G. Farlow informs me that he had already come to the conclusion that these "naked favellæ" are asexual organs, and he frequently finds on specimens from the coasts of New England some normal tetraspores on the same plants. I have not found these on the same plants here. I may add that I have never seen the true cystocarps naked, but always involucrate; and the tetraspores have always been of the normal character. My opinion is, then, that *Plumaria elegans* possesses neither "naked flavellæ" nor "polysporic tetraspores;" but that, in addition to the three kinds of reproduc-

tive organs usual in the Florideæ, this beautiful plant produces *polysporangia* containing sixteen large spores, and that these, like the tetraspores, are asexual.

Explanation of Plates.

(Figs. 1-39 refer to antheridia.)

Plate XIII.

Fig. 1. *Choreocolax Polysiphoniæ.*—Part of surface × 200.
„ 2. Ditto. Portion of vertical section × 400.
„ 3. *Harveyella mirabilis.*—Antheridia *in situ* × 10.
„ 4. Ditto. Portion of vert. sec. × 200.
„ 5. *Phyllophora rubens.*—Antheridia *in situ.* Natural size.
„ 6. Ditto. Exterior view of cavity × 200.
„ 7. Ditto. Vert. sec. of same × 200.
„ 8. *Cystoclonium purpurascens.*—Part of transverse section × 200. The dark body is an unchanged cortical cell.
„ 9. *Sphærococcus coronopifolius.*—Surface × 400.
„ 10. Ditto. Sec. of same × 400.
„ 11. *Gracilaria confervoides.*—Piece of male filament × 20.
„ 12. Ditto. Surface view of cavity × 200.
„ 13. *Rhodymenia palmata.*—Surface × 200.
„ 14. Ditto. Sec. × 800.
„ 15. *Rh. Palmetta.*—Two antheridia. Nat. size.
„ 16. Ditto. Surface × 200.
„ 17. Ditto. Sec. × 800.
„ 18. *Lomentaria articulata.*—Part of trans. sec. × 400.
„ 19. *Nitophyllum Gmelini.*—Portion of male plant × 2.
„ 20. Ditto. Trans. sec. of bilateral process × 20.
„ 21. Ditto. Part of ditto × 200.

Plate XIV.

Fig. 22. *Delesseria alata.*—Fragment of male plant. Nat. size.
„ 23. Ditto. Trans. sec. of antheridium × 50.
„ 24. Ditto. Part of ditto × 400.
„ 25. *D. ruscifolia.*—Male leaflet × 10.
, 26. Ditto. Sec. through two male spots × 50.

Fig. 27. Ditto. Part of ditto × 400.
,, 28. *Hydrolapathum sanguineum.*—Group of male leaflets removed. Nat. size.
,, 29. Ditto. Portion of surface and border × 50.
,, 30. Ditto. Part of sec. × 400.
,, 31. *Bonnemaisonia asparagoides.*—Antheridium from monœcious plant × 400.
,, 32. *Odonthalia dentata.*—Fragment with antheridia *in situ.* Nat. size.
,, 33. Ditto. Male leaflet × 10.
,, 34. Ditto. Portion of surface near edge of ditto × 100.
,, 35. Ditto. Trans. sec. of leaflet × 50.
,, 36. Ditto. Portion of ditto × 400.
,, 37. *Halarachnion ligulatum.*—Filamentous branches which bear antheridia. Nat. size.
,, 38. Ditto. Surface with two antheridia × 400.
,, 39. Ditto. Sec. of ditto × 400.
,, 40. *Harveyella mirabilis.*—Cystocarp × 10.
,, 41. Ditto. Tetrasporic plant × 10.
,, 42. Ditto. Cruciate tetraspores from ditto × 200.
,, 43. *Ahnfeldtia plicata.*—Portion of vert. sec. of nemathecium with spores × 400.
,, 44. Ditto. Upper portion of a tube containing a spore × 800.

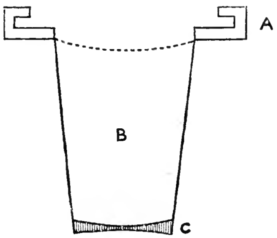
A Photo-Micrographic Camera.

By J. D. Hardy.

(*Read September 15th, 1893.*)

It is often very desirable to photograph an object as it is seen under the microscope without disturbing it or having to alter any of the arrangements. For this purpose I have devised this instrument, which I exhibited at the R.M.S. three years ago, but as it was not reported or figured, and I have been frequently asked for a description, I take the opportunity of having it here this evening to show it and explain its various parts.

Referring to the diagram, which is a vertical section made to a working scale, A is a flat piece of cedar (cigar box) wood



$2\frac{1}{2}$in. square, having a circular hole cut in it $1\frac{1}{2}$in. diameter. This is the plate-holder. Along three of its sides runs a flange. B, is a cone made of stiff (or brown) paper 2in. long, having an opening at the bottom of 1in. diameter, and glued to the top, to the under side of the flat, by its flange. All the parts should be painted dead black. Inserted and fixed at the bottom of the cone is a double concave lens, C, having a negative focus of 9in., though other lenses having a deeper curvature may be employed.

A cardboard cover or lid is made to fit loosely over the top of the plate-holder to keep out the light during exposure.

To use it. The object having been focussed, the eye-piece is

taken out, the cone of the camera is inserted easily but firmly in the tube of the microscope, care being taken that the plate-holder is parallel with the stage. Focus with an old thin piece of sensitive plate, which has been "exposed" and developed, with a fairly transparent film (any ground glass is much too coarse for the purpose). This is cut to size so as to drop easily on to the plate-holder; the film side downward, so as to correspond with the position of the sensitive plate exactly. Focussing can be done with an ordinary watchmaker's lens. Having focussed the object on the focussing plate, remove it carefully, turn down the lamp as low as possible, and drop a piece of sensitive plate on to the plate-holder; put on the lid and turn up the light. Exposure is a matter of experience, as objects differ in photographic quality according to density or colour. The O.G. power has also to be considered. As a time direction I find that with a good lamp light and 1-inch O.G. from one-and-a-half to two minutes is sufficient. After exposure the light must be again turned down and the plate removed to dark box. Unless it can be developed at once, two or three exposures should be made with different times. If you do not do the developing yourself any photographer would do it, care being taken to let him know the class of object and what to look for; but this and other matters are within the experiences of photography.

The flange is for the purpose of inserting a dark slide when the light cannot be turned down. It is one of Marion's metal slides, which are sold with their Academy camera, of about 2in. square. As it is very convenient to have one or more of these they should be obtained previously to making the camera, so that the flanges may be made to fit easily. When focussing for this dark slide a thicker piece of plate should be used, the film side uppermost, so as to correspond with the plane of the plate in the slide.

The aim of the whole is to make an instrument practically useful, sufficiently light so as not to disturb the position of the microscope, and also to place the sensitive film in exactly the same plane as the focussing plate.

Mr. Hardy afterwards exhibited the negative of a diatom (*Coscinodiscus excavatus*), showing the markings on the secondary film and of 1in. diameter.

Notes on Rotifers.

By G. Western, F.R.M.S.

(*Read September 15th*, 1893.)

Callidina sordida=*Callidina longirostris*, Janson.—This Rotifer is one of those I brought to your notice as new species in October last year, and you will find my description and figure in the July number of our Club Journal. I have since seen a paper on the Philodinadæ by Dr. Otto Janson, of Marburg University, in which he also describes it under the name of *Callidina longirostris*. As it would only cause confusion to retain the two names for the same animal, I propose to cancel that I gave it, and in future to recognize it as *Callidina longirostris*.

Rattulus bicornis.—On the same occasion I described a small Rattulus under this name. I regret to say that an error has crept into the description which, if uncorrected, would materially interfere with its future identification. The toes are equal in length, and not unequal as stated. Mr. Rousselet has also brought to my notice that on separating the toes by the use of a compressor, a third substyle, about two-thirds the length of the toes, becomes visible. The description should therefore be—"Toes equal, substyles three." Mr. Rousselet has also made a very accurate figure of the trophi of this Rotifer, which, at my request, he will publish in the forthcoming number of the Journal. I may mention that in Wierzejski's work on the "Rotifera of Galicia" there is a description and figure of a new species of Cælopus, *C. similis*. The figure has such a close resemblance to this Rotifer of mine that I think it more than probable a doubt may arise as to whether they are not really identical. I therefore state that the one I describe is certainly a Rattulus, as I shall be pleased to demonstrate to any particularly interested by exhibition of specimens.

Note on Lietz New Microscope Stand.

By Edward M. Nelson, F.R.M.S.

It is with surprise as well as pleasure that, owing to the energy of one of the foremost continental microscope makers, I am able to place before you a new stand, which is a further departure from the "Oberhäuser," and a nearer approach to the "English" model than any continental instrument hitherto constructed.

The first striking feature is the absence of the heavy horseshoe foot, its place being occupied with the bent claw, its spread being 5in. by 6in.

The lightness and stability of the stand are at once apparent; when the instrument is placed in a horizontal position, and the tubes are fully extended, its centre of gravity is well within its base; this microscope, therefore, has no need of a second and more extended foot similar to those supplied to Zeiss microscopes.

The next feature is the adaptation of my horseshoe stage in place of the narrow stage with the small hole in it. The usefulness of this stage is unfortunately largely curtailed by having the grooves for the sliding bar ploughed on its face. The sliding bar is moreover provided with spring clips, which ought to be removed. These, of course, completely render nugatory the advantage of the horseshoe stage, because the working distance cannot be felt. Spring clips on the stage have been the means of breaking more fronts of object glasses than all other pieces of apparatus put together.

The lugs of the sliding bar project above the level of the stage; this interferes with the free movement of the slip.

The body is the same as in all continental microscopes, the coarse adjustment has oblique rack work, and the fine adjustment is of the plain direct type, one revolution of the head causing a movement of one-fiftieth of an inch, a motion three or four times more rapid than in the best instruments in this country.

The microscope is fitted with a substage taking an Abbe chromatic condenser of the two lens type; this part of the substage is fitted with rectangular centring screws, the two screws pushing a ring against a spring. Beneath this there is an iris diaphragm, having 13 leaves, and of first-rate manufacture; in fact, the smoothest working iris I ever handled. This iris is not attached to the same fitting as the condenser, and therefore it is not controlled by the centring screws. It turns out on an arm, and is fitted with Abbe's rack work eccentric gear, which is perfectly useless, and much in the way. It would have been better if the iris had been attached to the bottom of the centring ring; it would then have been centred together with the optical part.

This condenser fitting is drawn out into a kind of tail piece, to which the mirror is attached! It follows, therefore, that when you alter the focus of your condenser you move also the mirror, and consequently alter your light! With daylight this would hardly be noticed, but with lamplight it must cause serious inconvenience.

We now come to an altogether novel procedure in microscope construction. This is to be found in the substage rack work. It is well-known that two methods are in vogue here, viz., a right and a wrong way, the right method being that of sprung grooves, and the wrong being a solid ploughed groove, the tightening up being performed by forcing the pinion into the rack. Here, we have an entirely new departure. Fig. 1, shows the plan of the substage slide. Fig. 2, shows the elevation, and Fig. 3 the elevation of the ploughed groove fixed to the microscope stand. The first thing that strikes one is that the rack is not in the groove, but at one side of it, Fig. 1, so also is the pinion in the other part, Fig. 3.

Secondly, there is no V-shaped groove at all, but instead of this there is a flat piece of steel (see shaded portions of Figs. 1 and 2), which is pressed downwards by a spring, this is tightened up by a screw, shown at the lower part of Fig. 2. This, of course, engages in the slot of Fig. 3, the flat part of the slide bearing on the small flat tops of the slanting portions of Fig. 3.

This seems to be a very simple and smooth form of slide for microscope movements. It is quite new, and, therefore, it

would be premature to say that it is efficient, time alone can decide that question, but, so far as one can judge, it would seem that we have here a useful addition to our microscopical contrivances. Notwithstanding these alterations, the price of the instrument remains unchanged.

In conclusion, I would suggest four improvements :—

1st. That the toes of the claw foot be not bent inwards; the spread then would be 6 × 6 inches.

2ndly. That the stage be made perfectly plain, the lugs of the sliding-bar bearing on the edge instead of on the face.

3rdly. That the iris be fixed to the condenser fitting, the turn out and rack work eccentric motion being removed.

4thly. That differential gear be put to the fine adjustment, so as to make it about three times slower than at present.

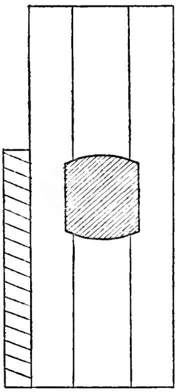


Fig. 1.

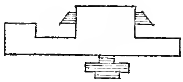


Fig. 2.

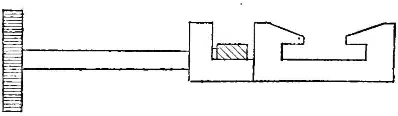


Fig. 3.

EXPLANATION OF FIGURES.

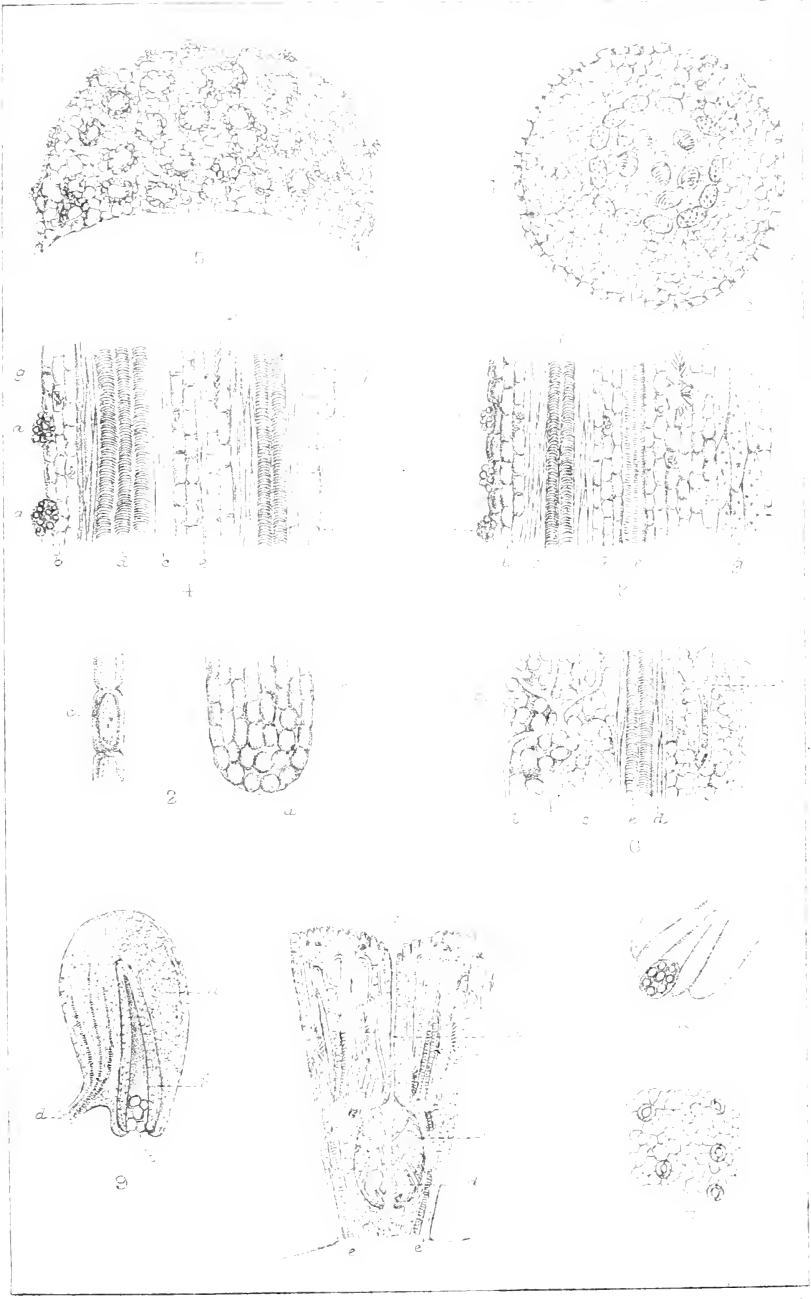
Fig. 1. Slide carrying substage (plan).
,, 2. The same (elevation).
,, 3. Pinion and slide fixed to microscope (elevation).

Note on the Recorded Localities for Rotifera.

By Surgeon V. Gunson Thorpe, R.N.

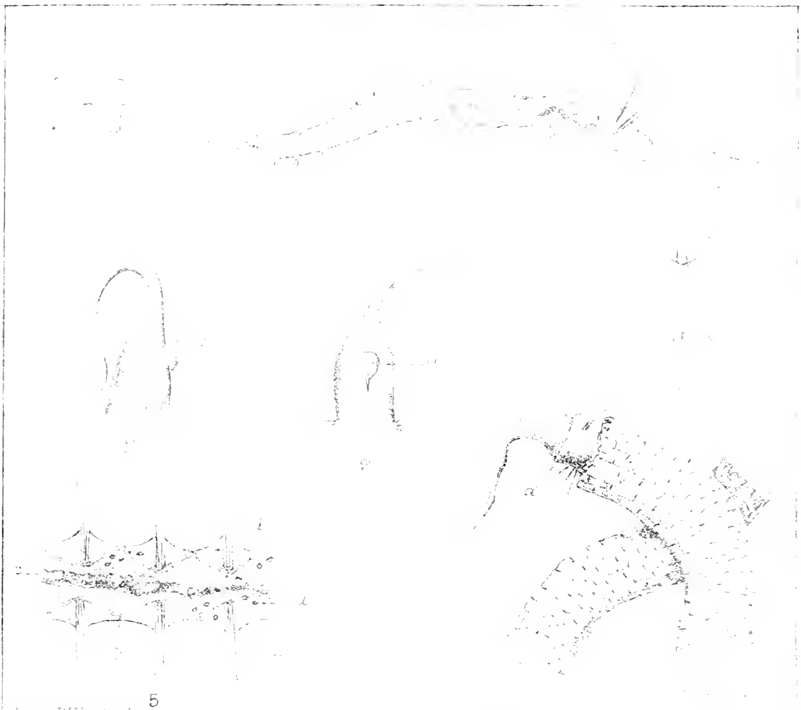
1. *Stephanoceros Eichornii*, Botanical Gardens, Singapore.
2. *Melicerta ringens*, Botanical Gardens, Singapore.
3. *Philodina citrina*, Cape of Good Hope.
4. *Asplanchna Ebbesbornii*, Botanical Gardens, Sydney, Australia.
5. *Hydatina senta*, Fountains of Shinto, Temple Osuiva, Nagasaki, Japan.
6. *Metopidia solidus*, Delagoa Bay, East Africa.
7. *Brachionus pala*, Cape of Good Hope.
8. *Brachionus dorcas*, Cape of Good Hope.
9. *Brachionus urceolaris*, Cape of Good Hope.
10. *Brachionus angularis*, Cape of Good Hope, also a variety at Osuiva Temple, Nagasaki, Japan.
11. *Asplanchnopus myrmeleo*, Sydney, Australia.

Henry W King del. Newman lith.

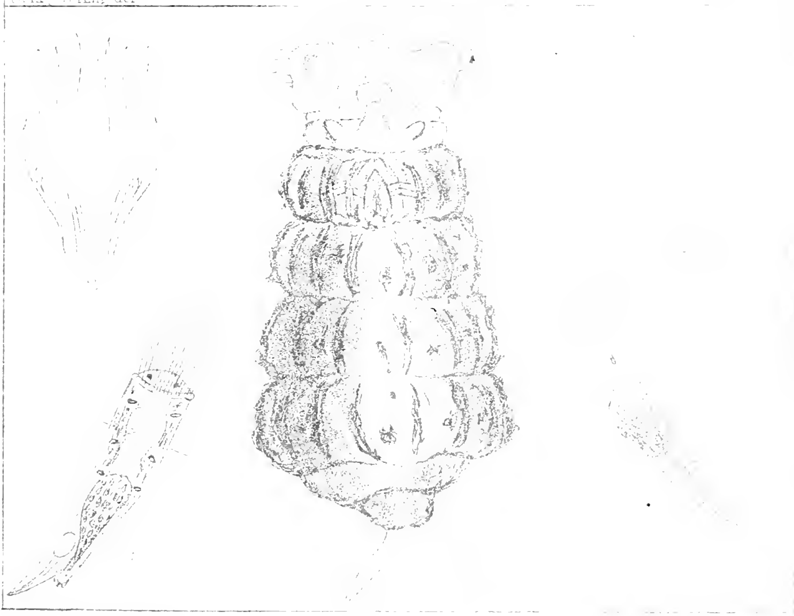


Henry W. King del. West, Newman lith.

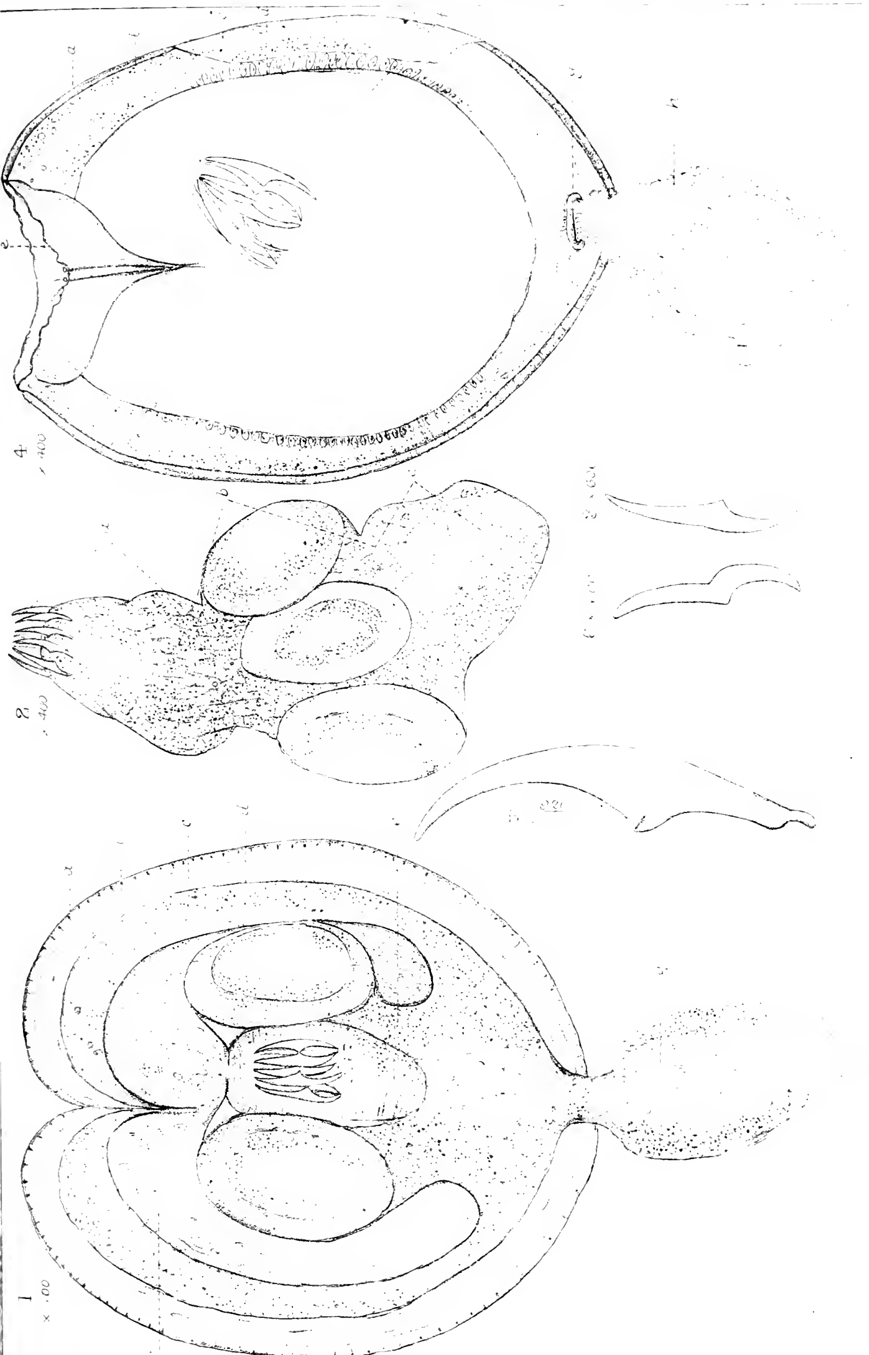
Hen... King del. West Newman lith.



Henry W. King del.

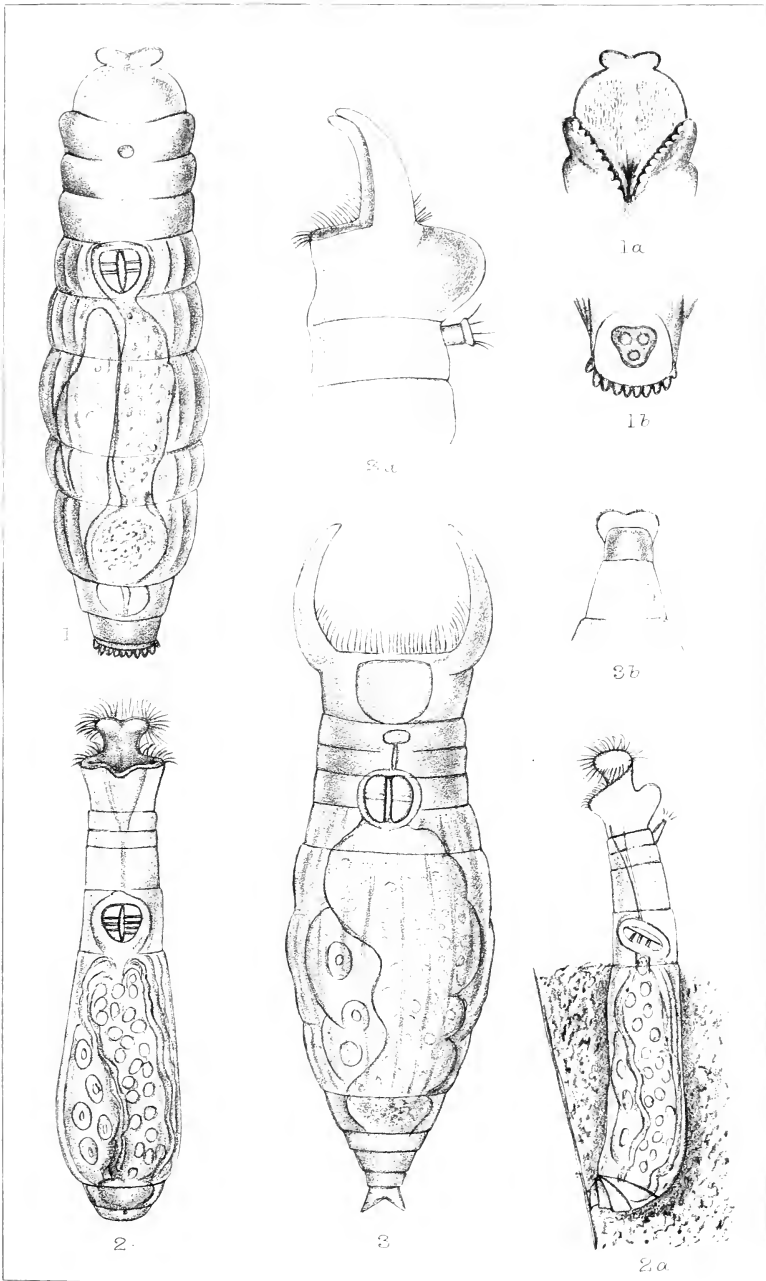


W. Ingram Chapman del.



T.B. Rosseter del.

West, Newman lith.



D. Bryce del.

West Newman lith

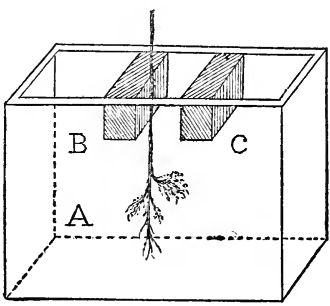
Note on a Method of Exhibiting Pond Life.

By W. Burton.

Having at times experienced some little difficulty in getting objects, attached to weed or rootlets, into a favourable position for observation, I have lately adopted a plan which is both simple and effective.

A, is an ordinary shaped tank, into which, before filling, fix a small plug of cork, B, a little out of the centre; then having filled the tank with a pipette, place the weed against the cork, to which it will readily adhere. Then take another cube of cork, C, fitting loosely, and place it against the weed, which will then be held, as in a vice.

This is especially useful when the object is on flat weed, or vallisneria, as it is generally found that on putting such into a tank, it either turns round and presents the flat side to the observer, or else floats away to the top, in either case rendering observation difficult, and often impossible.



A. Ordinary stage tank.
B. Cork plug fitting firmly.
C. Cork plug fitting loosely, so that it can be pushed up close to B, after the the object is placed in position.

PROCEEDINGS.

March 3rd, 1893.—Conversational Meeting.

The following objects were exhibited :—

Anceus maxillaris, ♀ *Crustacea Isopoda*	Mr. E. T. Browne.
Paludicella articulata	Mr. W. Burton.
Lagena costata	Mr. G. E. Mainland.
Navicula notabilis	Mr. W. Morland.
Anurœa, sp. *Rhinops orbiculodiscus*, *Notops minor*...	Mr. G. Western.

March 17th, 1893.—Ordinary Meeting.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. Percy Thompson was balloted for and duly elected a member of the Club.

The following additions to the Library were announced :—

"Science Gossip"	The Editor.
"Proceedings of the Natural History Society of Glasgow"	The Society.
"The Botanical Gazette"	In Exchange.
"Annals of Natural History"	Purchased.

Mr. Karop said he had also received some slides for presentation to the Club from Dr. Gray, who was well-known to many as a very excellent mounter, and who was for many years a member of the Club. These slides were left for him at the Hospital by Dr. Gray in September last, but as he was away at the time they were put aside, and until Dr. Gray made some inquiry about them recently he was unaware of their having been sent. Fortunately, after some search the

parcel was discovered, and he had brought them to the meeting that evening; they were, as might be expected, very excellent slides, and they would be a very valuable addition to their cabinet.

Mr. J. E. Ingpen said they would be very glad to have this memento of Dr. Gray, whom he was very sorry to lose as a member of the Club. The older members would remember very well the valuable services he used to render during years when he was a member of their committee, and felt sure that this donation would be greatly appreciated by all who knew him.

The President said that when Dr. Gray left London he lost a personal friend. He certainly never had met with a more earnest and thorough worker or one who devoted himself more disinterestedly to the advancement of microscopical science.

A hearty vote of thanks to Dr. Gray was unanimously passed.

Mr. Karop said they had also received a donation of slides of Foraminifera from the Andaman Islands and other places from Mr. Jenkins.

Mr. Karop exhibited and described a microscope lamp made by Mr. Swift on the Nelson-Dallinger pattern, but having an arrangement for putting the blue glass in front of the doublet, instead of in the side of the chimney, where it was very apt to get cracked by the heat. Another improvement consisted of a metal ring, which was put round the top of the chimney and connected to the upright stem, which acted as a conductor and conveyed the heat away from the chimney to the stand and greatly modified the amount, which was so inconveniently radiated from the hot chimney under ordinary circumstances. The price, inclusive of the condenser and blue glass, was about 50s.

The President said it was a good idea to separate the glass from the chimney. He much preferred, however, the blue glass to be mounted upon a separate stand, as being more easily removed when not wanted. He fancied that there might also be some inconvenience in conducting the heat to the body of the lamp, where it might so overheat the oil as to cause it to boil.

Mr. Karop said it had been kept alight continuously for six

hours without the oil becoming overheated. The great defect common to all paraffin lamps was the oil getting out by creeping; could not some kind of oil-tight tap be invented to stop this?

Mr. Hardy said he had in a lamp which he made some time ago done something to prevent both the things complained of; by using a wick much smaller or narrower than the burner, and by having a longer tube to put the oil in at and made with a hole in it, which allowed the air to freely get to the oil and so kept it much cooler.

Mr. Ingpen said that he had found some advantage in using the small lamps which were made to burn without chimneys, but the same result could be attained in the way suggested by Mr. Hardy, by using a wick much smaller than the burner.

Mr. Karop said he had a small paper model sent by Dr. Gunson Thorpe, which he believed was intended to represent the lorica of a Brachionus, in illustration of his paper which they were unable to read at their last meeting, in consequence of its being the annual meeting.

Mr. Western said he felt at a disadvantage in saying anything upon the subject of a paper which he had not seen, but he had been in correspondence with Dr. Gunson Thorpe on these matters, and could say that this model was meant for the lorica of a Brachionus. The main idea was that the shell was usually described as a box, but Dr. Thorpe thought it would facilitate description if, instead of being considered as a box, it was said to be made up of three plates, which he proposed to term dorsal, ventral, and posterior. Having drawn this type upon the board, Mr. Western pointed out that, whilst it agreed very well with the species mentioned, there were some which it was much more difficult to identify with this description.

Mr. Western read a paper, contributed by Mr. Hood, of Dundee, on a new Rotifer which he had discovered. The species had not yet been named by Mr. Hood, but Mr. Western hoped to be able to induce him to send them some further descriptions, with drawings.

Mr. Bryce thought the most interesting point in the description given was that which related to the duplication of the eye-spot, because, so far as he knew, there was no other instance of

the occurrence of two eyes, though in some cases with a high power the apparently simple eye could be resolved into two, but it was very unusual in Synchæta. There were, he thought, some reasons for suggesting whether this specimen was mature.

Mr. Western said it was undoubtedly mature, because it contained eggs, and also the eye-spot.

The thanks of the meeting were voted to Mr. Western and to Mr. Hood for this communication.

Mr. R. T. Lewis said it would, no doubt, be remembered that at the meeting of the Club in January, 1892, he read a short paper "On a Species of Ixodes found upon a South African Lizard." This paper was printed in the last number of the Journal, and illustrated by a plate. Having by request sent to Mr. Michael a reprint, in which the figure was coloured, he had been struck by its resemblance to one described by Lucas at the *séance* of the Entomological Society of France, in July, 1845, and published in the annals of that Society, with a coloured plate. Lucas's specimens were found upon a python imported from Senegal to the Zoological Gardens in Paris, and on reading the descriptions and comparing the measurements with those of the specimens from the lizard he came to the conclusion that the two were probably of the same species, or, if not, they were very closely allied. The chief difference appeared to be in the shape of the markings on the dorsal surface, which seemed a little too symmetrical to be quite natural. He had mentioned in his paper that there were some specimens at the British Museum which were unnamed, and in the absence of any other name it was proposed to call the species *Ixodes Varani*, after the Varanus Lizard, upon which his specimens had been found. If, however, they were really identical with those described by Lucas, the name given by him, *Ixodes Flavomaculatus*, must be substituted. Mr. Lewis also called attention to a slide exhibited under a microscope in the room, containing some objects which had been sent to him under the impression that they were animal parasites. They had been found upon the new Marsupial Mole, *Notoryctes typhlops*, discovered by Mr. Coulthard in 1888 at Idracowra, in Central Australia, and subsequently described and figured by Dr. Stirling in the proceedings of the Royal Society of

Australia. It was assumed that the parasites of so rare and remarkable a creature would possibly prove to be equally remarkable, and having been sent first from Australia to New Zealand, they were subsequently forwarded to England with a request that he would examine and describe them. A very slight examination sufficed to show that they were of two kinds, of which the first were the spinous seeds of some plant entangled amongst the finer hair of the mole, and the others were the heads of a small species of ant. It was mentioned by Dr. Stirling that *Notoryctes* appeared to be an insect feeder, and that the remains of ants were found in its intestines; the inference, therefore, was that this mole had been raiding or burrowing in close proximity to an ants' nest, and had been attacked by the garrison in force, each ant seizing as much fur as it could grasp with its mandibles and holding on with a determination stronger than its neck. The mole was, amongst other things, remarkable for the extreme rapidity with which it burrowed in the sandy soil of its native country, and it would, no doubt, easily sweep off the bodies of its foes by that means.

Mr. Michael said with regard to the tick he had been struck by the similarity between the coloured plate with which Mr. Lewis had illustrated his paper and the drawing given. As stated by Lucas, he had drawn attention to it, and had himself little doubt that the two species were identical. The variation in the markings in ticks of the same species, and even in those of the same individual under different circumstances, were so remarkable that he did not lay much stress upon the differences noted. With regard to the Marsupial Mole, it had excited more attention than any other zoological discovery of late years, but it was an absolute mistake to call it a mole, because it was really no ally of the mole whatever.

Mr. Karop announced that the Journal was in the hands of the printer, and would be now very shortly issued. The death of their late Editor, Mr. Hailes, had been a matter of much trouble, and to this cause some of the delay was undoubtedly due.

The following objects were exhibited :—

Plumatella	Mr. F. W. Andrew.
Asplanchna Brightwellii	Mr. W. Burton.

Supposed parasites, which are in reality the heads of ants, from *Notoryctes typhlops*	Mr. R. T. Lewis.
Ancient and Modern Lavas, showing flow structure	Mr. G. Smith.
A New Synchæta (Marine, with two eyes), sent by Mr. Hood, of Dundee	Mr. G. Western.

April 7th, 1893.—Conversational Meeting.

Fredericella sultana	Mr. F. W. Andrew.
Leptomedusæ, *Thaumantias Thompsoni*	Mr. E. T. Browne.
Hydatina senta	Mr. W. Burton.
Villi on small intestine of Cat, opaque injection	Mr. G. E. Mainland.
Notommata aurita (mounted)... ...	Mr. C. Rousselet.

April 21st, 1893.—Ordinary Meeting.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Members of the Club:—Mr. F. R. Greg, Mr. Arthur S. Vince, Mr. E. W. Hornsby, jun.

The following donations were announced:—

"Phycological Memoirs"	Purchased.
"American Monthly Microscopical Journal"	In Exchange.
"The Microscope"	"
"The Botanical Gazette"	"
"Proceedings of the Belgian Microscopical Society"	"
"Annals of Natural History"	Purchased.
"Science Gossip"	The Editor.
"Journal R.M.S.	The Society.
"Proceedings of the Naturalists' Society of Kiew"	"

"Proceedings of the Royal Society" ...	The Society.
"Proceedings of the Ealing Natural History Society"	"

The Secretary said that after some unavoidable delay the Journal was now in the hands of the Members, but it should be noted that the date had been printed on the cover by error as July instead of April.

Mr. C. L. Curties exhibited a new lamp with bull's-eye, which admitted of being readily centred.

The President thought this would prove to be a very convenient form of lamp. In his own form he had a sort of double action arrangement, but in this all was done by one movement. There was always a tendency on the part of the oil to creep down the side, and, therefore, when one was working with the microscope the less a paraffin lamp was touched the better.

Mr. Karop said lamps of this sort always would "creep," in spite of all dodges to prevent it.

The President said that when he first designed a lamp, in 1875, what gave him the idea of the square form was one which was originally made for use with Sir William Thompson's reflecting galvanometer, by White, of Glasgow. This was square in shape, made of tin, and held enough oil to enable it to burn for 24 hours. Instead, however, of placing the burner in the centre he put it at one corner, and had the filler at the other corner. Thompson's lamp cost 4s. 6d., but when he ordered one to be made for use with his microscope the bill came in for six guineas. His own lamp had been in constant use for 18 years, but he did not see why it should not have been made much cheaper.

Mr. Ingpen said this was another illustration of what they so often found, namely, that all things intended for scientific purposes were contrived to cost a great deal of money; and, therefore, it was often desirable to use some cheaper substitutes which might practically answer the same purpose. It would be found that the bottom of a broken tumbler, which originally cost 2d., would make as good a shallow cell for dissecting as a thing which was made to cost half-a-crown.

Mr. Karop said that no matter what they gave for a lamp, whether several pounds or only a few pence, the burner was sure to be of the commonest description.

Mr. Ingpen said the fact was that all the genius of inventors had been concentrated upon the idea of getting the best possible form of burner, so that it would be noticed that this part of a 6d. lamp was practically as good as one which cost six guineas, the idea being that of putting the greatest amount of intellect into the cap, and then producing the whole thing at the lowest possible cost. Some years ago he and Mr. Mogenie had the matter under consideration, and they examined every burner that was to be got. The workmanship of all was much about the same, and they came to the conclusion that, with the exception of the pinion, they could hardly hope to improve upon the American model.

The President having introduced to the meeting Herr Leitz, of Wetzlar, to whom a hearty greeting was given,

Herr Leitz said that in making experiments he had found the apochromatic lenses, as usually made, were subject to some disadvantages which seriously interfered with their usefulness. The chief of these was that the glass was not sufficiently durable, and therefore he had endeavoured, and succeeded at last, in making a lens of hard glass in which the secondary spectrum was absent in about the same degree as was the case with apochromatics, and he was glad to be able to say that so far as resolution was concerned, they could not see more difficult test objects with the apochromatics than with his new series. He had some specimens in the room of 2, 3, and 7 mm. focus, and should be glad for any of the members present to test and compare them with objectives of any other kind.

The President said he had seen these glasses, and was of opinion that they were certainly amongst the best which he had examined. The No. 7 pantachromatic was almost exactly equivalent to a quarter-inch, giving an initial magnifying power of nearly 40. It was a most beautiful glass to work with.

Mr. Stokes inquired whether these objectives needed any special form of eye-piece?

The President said that this was not necessary with the low powers, but with the higher powers a compensating eye-piece improved the image.

Mr. T. F. Smith said he had found it of great advantage to photograph an object without an eye-piece, and had got on very

well with all powers up to half-inch, but beyond that he found he was in difficulties because of the want of flatness of field.

The President inquired of Herr Leitz if he was doing anything to help them in the way of making a long tube series of lenses. Those which he had seen were all for short tube instruments, and he wanted to know if he could give them a little more extension. He must not expect a very large sale, because all students were now being taught that short tubes were the correct thing.

Mr. Ingpen asked if there were any difference between them except in the matter of adjustment; he understood from Professor Abbe that there was no other difference.

Herr Leitz said it was quite easy to make these objectives for the long English tubes, and he would be glad to do so if he found that there was a demand for them. There was no difference except in the adjustment.

The thanks of the meeting were unanimously voted to Herr Leitz for his communications.

Mr. C. L. Curties said he had brought for exhibition a specimen of Filaria, which had been sent from India. One drop of blood contained about 300.

The President reminded the members that in 1880 a very valuable paper on the subject of Filariæ, by Dr. Manson, of Amoy, was communicated to the Club by the late Dr. T. Spencer Cobbold, which was published in the Journal (Ser. i., vol. vi., p. 58, Plate xix.).

Mr. Karop said that quite a new paper had, he believed, lately been published by Dr. Manson on the subject, and which probably contained many new observations on this remarkable parasite.

Mr. Bryce read a paper on a new Rotifer, *Metopidia Parvula*, for which the thanks of the Club were returned.

The following objects were exhibited :—

Nassula ornata, Ehr.	Mr. F. W. Andrew.
Ophrydium Eichhornii	Mr. W. Burton.
Filaria sanguinis hominis New microscope lamp ...	Mr. C. Lees Curties.
Amphipleura pellucida, Pantachromatic objectives ...	Herr Leitz.
Notops brachionus (mounted)	Mr. C. Rousselet.

MAY 5TH, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Floscularia ornata	Mr. F. W. Andrew.
Euchlanis triquetra	Mr. W. Burton.
Sections of Foraminifera	Mr. A. J. Jenkins.
Pyrgodiscus armatus	Mr. H. Morland.
Floscularia pelagica, a new free-swimming floscule	Mr. C. Rousselet.
Hydatina senta (mounted)	,,
Melicerta ringens, tube constructed from carmine and indigo ...	Mr. J. C. Webb

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MAY 19TH, 1893.—ORDINARY MEETING.

E. M. NELSON, F.R.M.S., President, in the chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. A. A. C. E. Merlin, Mr. W. H. Southon, Mr. Douglas E. Seal, Mr. V. Blackman.

The following additions to the Library of the Club were announced :—

"The Anatomy of the Blow-fly," Part 4	By Subscription.
Sherborne's "Bibliography of the Foraminifera"	From the President.
"The American Monthly Microscopical Journal"	In Exchange.
"The Botanical Gazette"	,,
"Journal of New York Microscopical Society"	,,
"Proceedings Academy of Natural Sciences, Philadelphia" ...	,,
"Proceedings of the Chili Scientific Society"	,,
"Proceedings of the Belgian Microscopical Society"	,,
"Proceedings of the Royal Society, New South Wales" ...	,,
"Science Gossip"	,,
"Transactions of the Royal Society"	,,

"Journal of the Royal Microscopical Society"	In Exchange.
"Annals of Natural History" ...	Purchased.
"Ray Society's Volume for 1891" ...	"
"The Essex Naturalist"	The Editor.

The Secretary said they had also received a small donation of some interest from Mr Kitton—a slide of section of shell of Chiton, which was one made by John Quekett himself and figured in his "Lectures on Histology."

The thanks of the Club were voted to the donors.

Mr. C. L. Curties exhibited a new camera lucida just received from Leitz; it was in the form of an eye-piece and could be used with the microscope at any angle, the object being seen on a level with the stage. It had the Continental-size tube, but could be made to suit the English instruments if required.

Mr. Newton asked if Mr. Curties could give them any information as to how it worked. If the image was projected at the side of the stage he should expect that there would be a very great deal of distortion.

Mr. C. L. Curties said there always would be a slight distortion with any form of camera lucida, but a great deal might be done to obviate that by keeping the plane of the paper at right angles to the direction of vision.

Mr. Michael did not think that under any circumstances could they avoid distortion with a contrivance of this kind unless they drew upon the inner surface of a bowl, otherwise the amplification must always be different in the centre and at the margin of the field because of the difference in distance. The difference was less when Dr. Beale's reflector was used, but with other kinds the edge of the field was more magnified than the centre.

Mr. Newton inquired if this would be so when the Wollaston prism was used. Would the lines of a stage micrometer be seen distorted in this way?

Mr. Michael said this would certainly be the case; the divisions of $\frac{1}{100}$ inch would always be wider apart near the edge of the field when viewed in this way.

The President said Mr. Michael had stated what was the fact with regard to all these contrivances. The best of them was probably Beale's neutral tint reflector, but it was not suitable for all purposes, because the picture, though inverted, was not laterally transposed. Thus a micro-photograph of printed

matter which could be read in the microscope could not be read with Beale's neutral tint; moreover, it cannot be read whatever way you place the slide, so long as the cover glass is towards the objective. In order to read it with Beale's neutral tint the slide must be placed on the stage with the cover glass down and the slip next the objective. It behoves, therefore, every microscopist who makes drawings to bear this important fact in mind.

Mr. Karop exhibited some photographs of *Amphipleura*, which he thought deserved notice, and read a translation of a paper "On the resolution of *Amphipleura pellucida* by violet filtered light."

Mr. C. L. Curties inquired what condenser was used to show the lines as they appeared in the photograph.

Mr. Karop said that the firm of Zeiss had lent for the purpose one of their achromatic condensers of 1·6 N.A, the same as that of the lens.

The President said the resolution of the longitudinal striæ in *Amphipleura* was a much vexed question, because lines could be made to run over the object by using oblique light, and a photograph might in that way show them whether they were there or not. For his own part he should not believe in them until he had seen their spectra at the back of the objective.

Mr. Newton said that understanding it was the violet and blue rays which chiefly affected the photographic plate, and supposing they used ordinary light, would they not be apt to focus for the red and the yellow rather than for the violet and blue; whereas if monochromatic light were used could they not focus for blue with much greater certainty?

The President said that the apochromatic lens would save the trouble, because the rays were all brought to the same point, but the old lenses would need the light filter.

The thanks of the Club were voted to Mr. Karop for his translation of the paper.

The President said that there was in the last Journal a communication from Mr. Ashe describing a plan for estimating tube lengths. Since then he had sent them another paper, giving a much simpler method of doing the same thing.

Mr. Ashe then read his paper on the subject, drawing figures upon the black-board to illustrate the points dealt with. He thought it would be found a useful means of analysis as enabling them to determine how much of the magnifying power was due

to the objective, how much to the eye-piece, and how much to the tube length.

The President thought they had just had a very valuable communication, for which their best thanks were due to Mr. Ashe. He did not wish to monopolize too much of the time of the meeting, but he should like to take the opportunity of answering a question which was constantly being asked as to what was meant by tube length—between what points was the measurement taken. Mr. Nelson then gave some illustrations, writing the formulæ upon the black-board.

The thanks of the Club were unanimously voted to the President.

Mr. Buffham read a paper "On Recent Work on Marine Algæ," illustrating the subject by diagrams drawn on the board.

Mr. J. G. Waller said this subject was one which had greatly interested him. The first paper he read at the Club was on the "Conjugation of *Actinophrys sol*," and the last was on "The Perforation of Shells and Stones by some Vegetable Organisms." In the course of his investigations on the subject he had met with a number of singular appearances, which on consideration he had referred to the action of fungi, and in this idea he was confirmed by Mr. Carter and others. There seemed to be an analogy between this action and what was known as the fungus foot of India. Mr. Buffham's specimens were found amongst the Algæ, but his own all came from the sands of the German Ocean. He was sure the paper would be a very useful addition to the Journal.

The thanks of the meeting were voted to Mr. Buffham.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Marine Algæ with reproductive organs:—*Chorda filum* (plurilocular sporangia); *Giffordiapadnicæ* (antheridia and plurilocular sporangia); *Gomontia polyrhiza* (an alga which perforates shells), sporangia; *Gonimophyllum Buffhami* (a parasite on *Nitophyllum laceratum*), antheridia, crystocarps, tetraspores	Mr. T. H. Buffham.

Euchlanis pyriformis	Mr. W. Burton.
Filaria sanguinis hominis (living)...	Mr. C. Lees Curties.
Painted Pond Life	Mr. C. Rousselet.

JUNE 2ND, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Vaginicola cincta	Mr. F. W. Andrew.
Melicerta tubicolaria	Mr. W. Burton.
Fredericella sultana	Mr. Stanley von Lösecke
Pedicellaria of *Uraster glacialis* ...	Mr. G. E. Mainland.
Brightwellia pulchra, Grunow=*B. coronata*, Grev.	Mr. H. Morland.
Triphylus lacustris (living and mounted)	Mr. C. Rousselet.

JUNE 16TH, 1893.

E. M. NELSON, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club: Mr. Frank E. Filer, Mr. H. Pannoll, Mr. Ernest Tugwell.

The following donations to the Club were announced :—

"Proceedings of the Royal Institution of Cornwall"	From the Society.
"Proceedings of the Western Microscopical Club"...	"
"Proceedings of the Hertfordshire Natural History Society" ...	"
"Proceedings of the Geologists' Association"	"
"Proceedings of the Bristol Microscopical Society"	"
"Proceedings of the Belgian Microscopical Society"	"
"The Botanical Gazette"	From the Editor.
"The Microscope"	"
"The American Monthly Microscopical Journal"	"

"The Essex Naturalist"	... ...	From the Editor.
"Science Gossip"	... ...	"
"Le Diatomiste"	... ...	"
"La Nuova Notarisia"	... ...	"
Paper by Jansen on the "Philodinæ"	...	Mr. Rousselet.
"Annals of Natural History"	... ...	Purchased.

The thanks of the Club were voted to the donors.

Mr. Karop said that some time ago Mr. Gill gave him some diatoms obtained from the river Lea. He wanted them for a particular purpose, but having put them in a window and left them they got spoilt for what he wanted them for. However, he cleaned the material, and on examining the result came across a specimen of a rather uncommon species—*Stauroneis legumen*, Ehrenberg. It had recently been noticed in an American journal as having been found in America, but it was hitherto unreported from the river Lea as far as he knew.

Mr. T. F. Smith exhibited and described a new objective by Swift, which had been sent to him for examination. It was a $\frac{1}{12}$th oil immersion, not apochromatic, but entirely free from colour. By way of testing it he had taken some photographs with it, and also for comparison with one of Zeiss's apochromatics of 1·4 N.A., and though he could not say that it was in every respect as good, it was so good that there was nothing shown by the one that could not be seen with the other, and anything which could be photographed by Zeiss's came out true to focus with the new lens with an isochromatic plate.

The President said the photographs were both excellent specimens, but he thought there was a little balance in favour of the one marked with a ×, which he understood was taken by Zeiss's lens; they were, however, both marvellously good.

Mr. C. Rousselet read a paper by Mr. John Hood, of Dundee, describing three new species of Rotifers.

Mr. Western said he had seen one of the specimens mentioned, and could testify to the truth of the description given. He thought they were much indebted to Mr. Hood for forwarding them this account for publication in the Journal.

The thanks of the Club were voted to Mr. Rousselet and Mr. Hood.

Mr. Buffham read a paper "On the Antheridia of some Florideæ."

The President, in thanking Mr. Buffham, said that it was papers of that character which kept up the reputation of the Club more than anything else.

Mr. Karop said that the members of the Club would regret to hear that they had lost the services of their curator, Mr. Emery, after fourteen years of office. He had, from increase of other duties, been obliged to resign the work which he had performed so well during that period. Fortunately for the Club a volunteer had come forward to their assistance, Mr. E. T. Browne having very kindly undertaken the duties.

The President felt sure the members had heard with great regret of the resignation of Mr. Emery, who had so long filled an important office, one which involved very constant work and attendance. The members all knew Mr. Emery's untiring devotion to the work he had undertaken, as well as his ever ready help and assistance. He was sure the Club would give him their warmest thanks for his long services. It spoke well for the Club that another member was willing to sacrifice his time in its interest, and they were all much obliged to Mr. Browne for placing his services at their disposal.

Announcements of meetings, etc., were then made, the Secretary expressing a hope that members would return from their vacation with a good store of papers for the meetings of the Club. The following objects were exhibited :—

Antheridia, etc., of some Floridiæ (×45 and 200)	Mr. T. H. Buffham.
Argulus foliaceus (The Suckers) ...	Mr. W. Burton.
Cyclotella Kützingiana, (showing pseudopodia)	Mr. J. G. Grenfell.
Isthmia patruelis (stal :)—Africa ...	Mr. R. T. Lewis.
Œcistes ptygura	Mr. C. Rousselet.
Oil $\frac{1}{12}$ N.A. 1·3 by Swift (semi-apochromatic)	Mr. T. F. Smith.

July 7th, 1893.—Conversational Meeting.

The following objects were exhibited :—

Astasia trichophora (flagella easily visible)	Mr. F. W. Andrew.
Triphylus lacustris	Mr. W. Burton.

JULY 21ST, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Dero (respiratory organs)	Mr. W. Burton.
Sections of Foraminifera	Mr. A. J. Jenkins.
Furcularia tubiformis, n. sp. (from St. Lucia, W.I.)...	Mr. Henry W. King.
Lophopus crystallinus	Mr. Stanley von Lösecke

AUGUST 4TH, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Asplanchna Brightwellii	Mr. W. Burton.
Foraminifera, sections and casts of *Alveolina*, *Rotalia*, etc. ...	Mr. A. J. Jenkins.
Lophopus crystallinus	Mr. Stanley von Lösecke

AUGUST 18TH, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Œcistes crystallinus	Mr. F. W. Andrew.
Noteus quadricornis	Mr. W. Burton.

SEPTEMBER 1ST, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Hemiaulus Kittonii (frustule and one valve, each with spore, and one valve without spore) ...	Mr. H. Morland.
Alcyonella fungosa	Mr. H. M. Simmonds.

SEPTEMBER 15TH, 1893.—ORDINARY MEETING.

A. D. Michael, Esq., F.L.S., F.R.M.S., etc., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The names of the candidates for election at the next meeting were read.

The Chairman feared there was but little to bring before the members beyond a short paper by Mr. Western.

Mr. Western said his communication was rather in the nature of a correction. Last year he read a paper on some new Rotifers. One of these he named *Callidina sordida.* He had since found that Professor Janson, of Marburg, had also described this Rotifer, and had named it *C. longirostris.* As it was undesirable that there should be two names for the same thing, he proposed to drop the name he had given.

The Chairman inquired which name had the priority.

Mr. Western replied that his name was given first, but he believed that Professor Janson's had appeared first in print.

The Chairman said it had been held over and over again that it was not competent for an author to cancel his name if published. Once published, no one, not even the author, could alter it. The question was simply which was the earlier, but the crucial date was that of publication, and Professor Janson appeared to have priority in that respect, although probably not the first discoverer.

Mr. Ingpen suggested that if it were desired for a particular purpose to secure priority it might be necessary to publish the paper in some other journal, as the Club journal was published at long intervals.

Mr. Western said his other point was with reference to another Rotifer, *Auracula bicornis.* An error had crept into the description which would materially interfere with future identification.

The Chairman invited remarks on Mr. Western's papers, and proposed a vote of thanks to him for his communications.

Mr. Ingpen referred to the death of one of their oldest members, Mr. Charles Baker, the optician, of High Holborn, on the 9th instant, at the age of 79. Mr. Baker had rendered good service in the early days of microscopy by assisting in the introduction of good and cheap instruments, and more recently by his recognition of the value of the objectives of Zeiss, Reichert, Leitz, and others, which have proved so useful to microscopists. Though he rarely attended their meetings, he took a friendly interest in the welfare of the Club, and his premises at High Holborn have always been "a house of call for Queketters."

Mr. Hardy exhibited and explained his small photomicrographic camera.

Mr. Ingpen inquired the exact diameter and power of the negative lens, and was it a simple or an achromatic lens, as in the Barlow lens of a telescope?

Mr. Hardy said it was a simple bi-concave, about the same focus as the length of the tube. He did not find it affected the achromatism.

The Secretary announced the forthcoming meetings.

October 6th, 1893.—Conversational Meeting.

Callidina fusca, n. sp.	Mr. David Bryce.
Litus cynipseus, ♂ ♀ (Fairy Flies) ...	Mr. C. Machin.
Hercotheca mammillaris, from Howard's Grove, near Richmond, Va. ...	Mr. H. Morland.
Melicerta ringens (mounted) ... *Œcistes mucicola* (mounted) ... *Melicerta Janus* (mounted) ...	Mr. C. Rousselet.
Cristatella mucedo...	Mr. H. M. Simmonds.

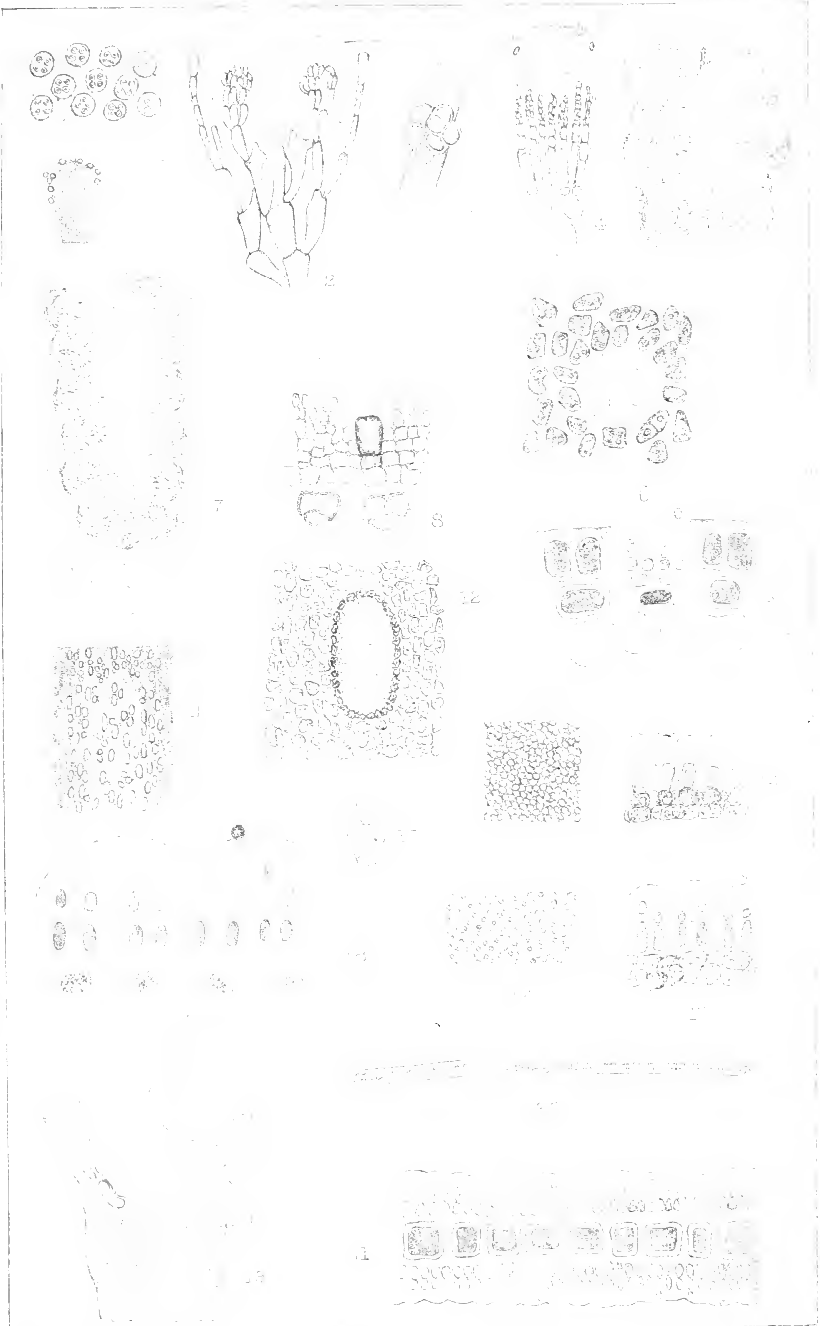
The Microscope and How to Use it. By T. Charters White, M.R.C.S., F.R.M.S.

The second edition of this little book by our old member and former president has just been published by Sutton and Co., Ludgate Hill. Written entirely for beginners, it omits nothing in the way of elementary manipulation likely to be required by a novice, and there are many practical hints of one kind or another scattered throughout the book, which would not be lost on those who have already acquired more than the rudiments of microscopy. The chapter on photomicrography is simple, concise, and to the point, and sufficiently explains the technique of this increasingly popular branch to those who have no previous acquaintance with it. The book is illustrated by some excellent photographs of insect parts, diatoms, etc., taken by the author, and as an introductory manual it can be cordially recommended.

NOTICE.

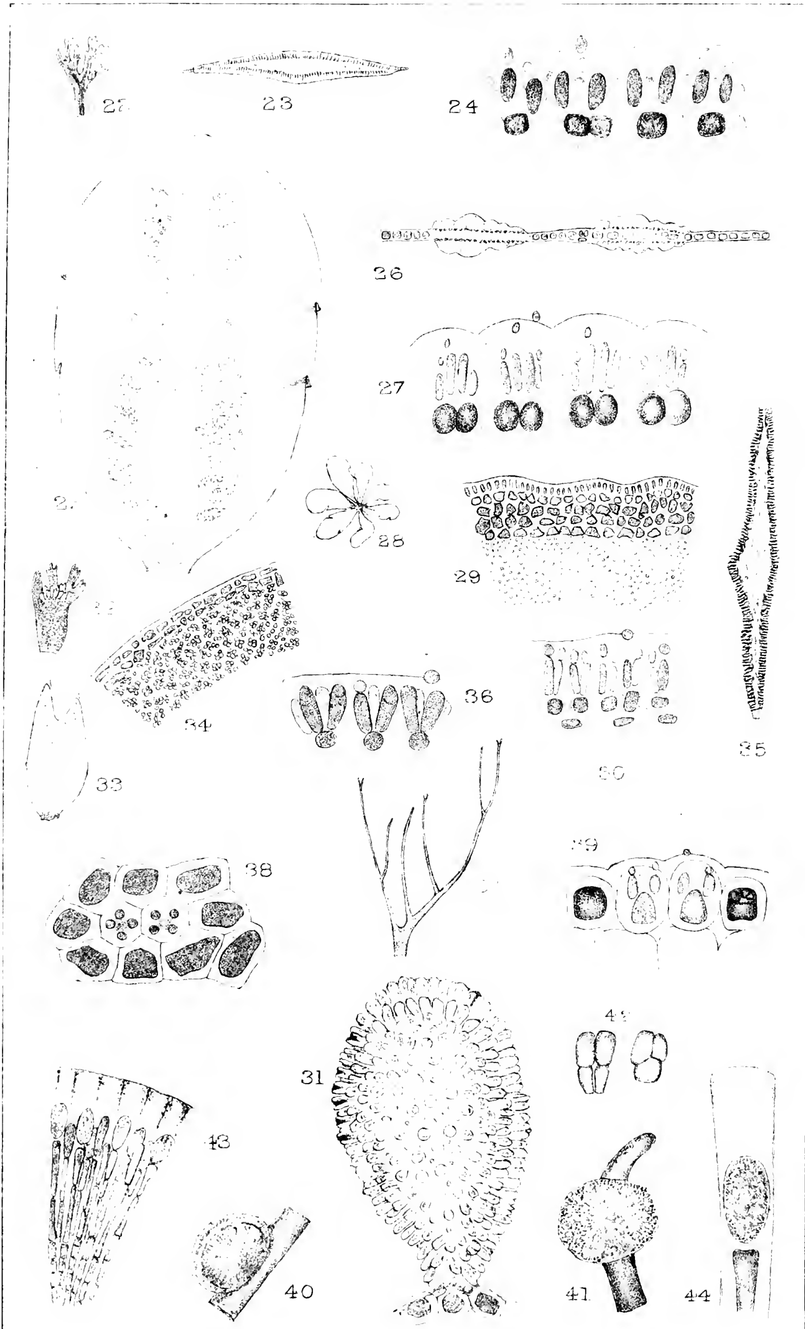
The "Hailes Collection" of dredgings, soundings, etc., has now been arranged by Mr. B. W. Priest, and is at the disposal of Members. Application for portions of the same must be made to the Committee.

John ... del. W... lith.

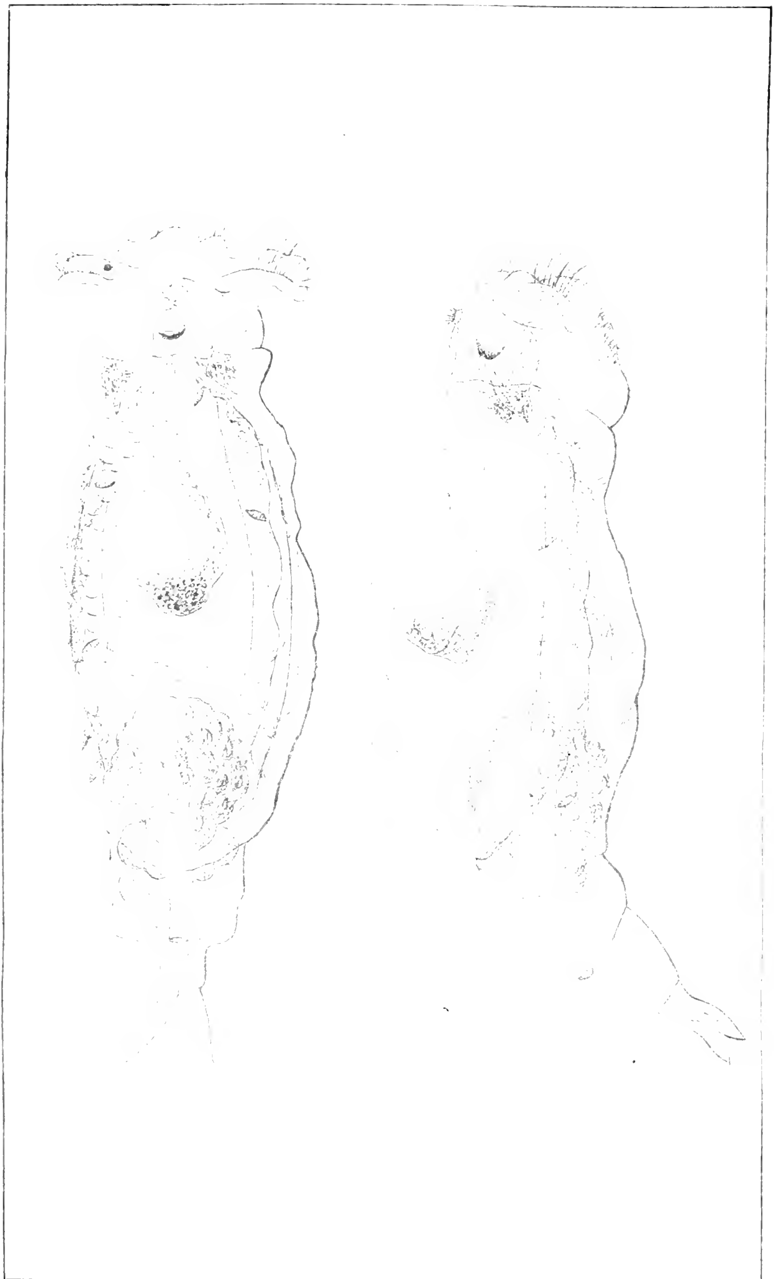


T. H. Buffham del.

Wm. Newman lith.

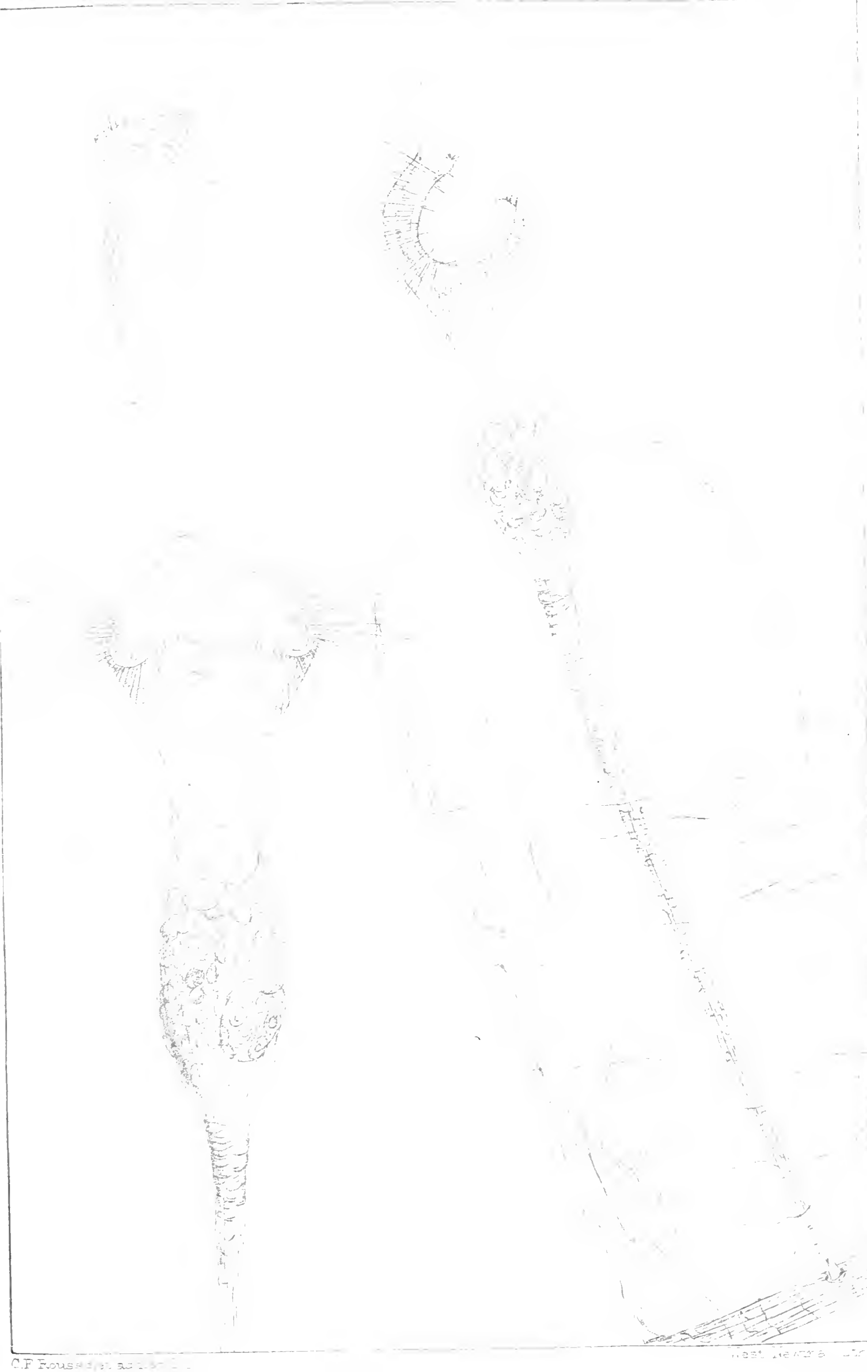


T. H. Buffham del. West, Newman lith.



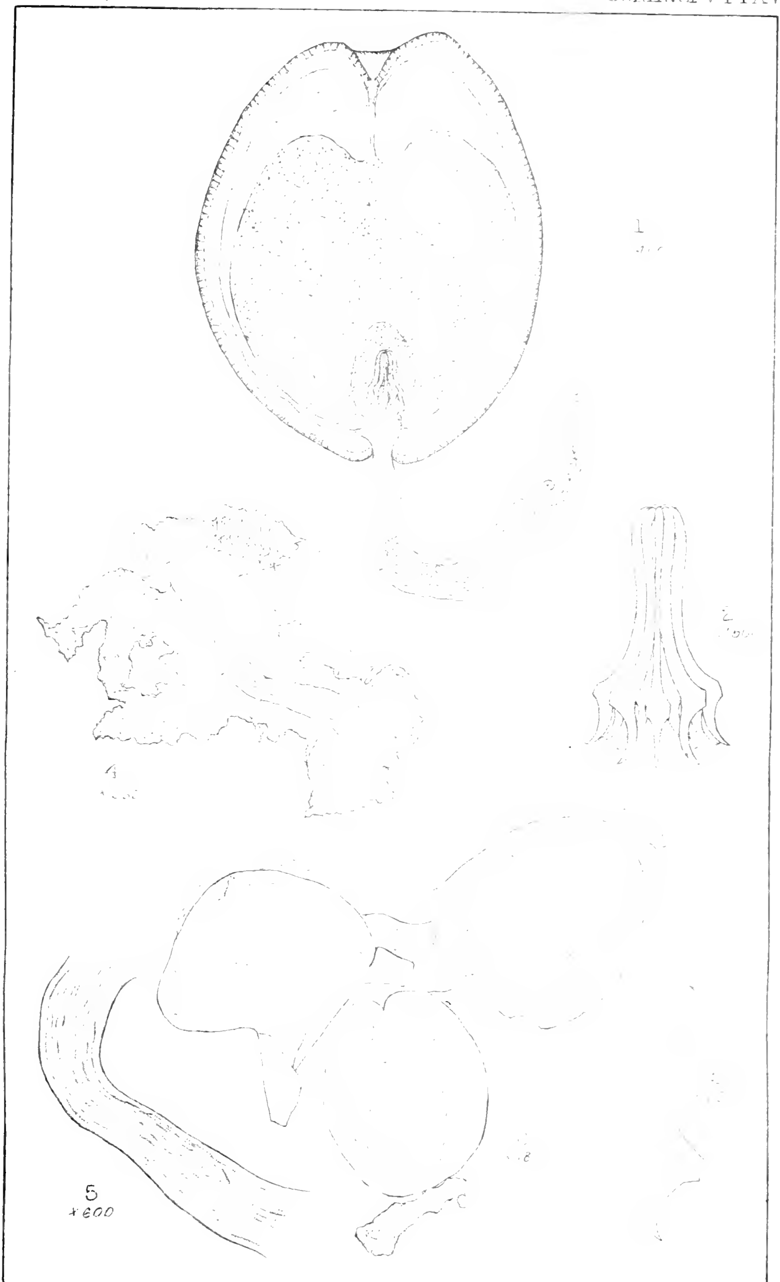
P. H. Thorpe-Nuttall del ad nat. West, Newman lith.

Copeus Pachyurus, *male*



C. F. Rouss... ad nat. del. West, Newman & Co. lith.

Floscularia Cucullata.



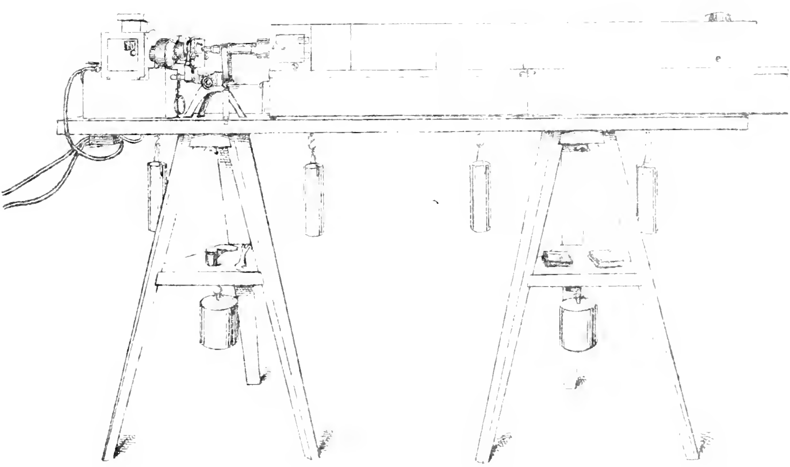
T. B. Rosseter del.

West, Newman lith.

Cysticercus Quadricurvatus

G.C. Karop del.

G.C. Karop ad nat. del.



West Newman lith.

Copeus pachyurus (Male).

By F. R. Dixon-Nuttall, F.R.M.S.

(Communicated by G. Western, F.R.M.S., October 20th, 1893).

Plate XV.

On the 1st August, 1893, I had a quantity of female *C. pachyurus* in a small zoophyte trough, and had the good fortune to see one lay two small eggs, which I at once thought would be males, and on looking carefully over the trough found several others. I removed a quantity of the females, leaving only a few, and put fresh pond water into the trough each day. On the 7th I found two full-grown males, and on the 8th there were at least half-a-dozen. I was unable to keep them alive long, for on the 10th not one could be found. I cannot say that this is any test as to the length of their natural life, as the weather was so exceedingly hot I was unable to keep the temperature of the trough as low as it would be in the ponds, and I had several eggs that did not hatch.

In general outline they are very much like that of a young female, are restless little fellows, and, unlike the females, seldom withdraw their auricles, but keep swimming in a somewhat spiral mode.

The brain, as in the females, is three lobed and of the same shape (though I am of opinion the two smaller lobes are a little more pointed, and in some cases slightly more granular or opaque). Each sac is filled with numerous cells, which give the covering or skin the appearance of being beautifully and evenly marked with a fine hexagonal pattern. This I have noticed is the case in the females too.

The occipital antenna stands at the base of the long lobe of the brain, and I also find this in both genders.

The eye is seated on a small ganglion, which rests between the two side or small lobes, and under the long, narrow neck of the centre lobe of the brain.

The cavity of the body, which in the female contains the mastax, stomach, etc., is filled with a large empty sac.

The lumbar tentacles, with their retractile setæ, are the same as in the female.

Four vibratile tags run down each side.

The large sperm sac and protusile, ciliated penis are obvious. I noticed the spermatozoa in active movement inside the sperm sac.

The size over all is $\frac{1}{95}''$.

On Floscularia cucullata, sp. n.

By John Hood, F.R.M.S.

(*Communicated by Chas. F. Rousselet, F.R.M.S., Nov. 17th, 1893.*)

Plate XVI.

Specific characters.—Corona divided into three lobes without knobs, the dorsal lobe much the largest, incurved and cowl-shaped, with two short horn-like prominences close together on the back; the two ventral lobes small; setæ, a double row, one row pointing inwards, the other outwards, fringing the whole circumference of the margin of the coronal cup; the inner row consisting of very short closely-set setæ, and the outer row of long, radiating setæ. Peduncle very short. Eyes absent in adult.

I first met with this large and handsome Rotiferon in the summer of 1881, but having found only a single specimen, and this one not in a healthy condition, I was at that time unable to make a satisfactory diagnosis, otherwise it would have been described and figured long ago in Dr. Hudson and Gosse's "Monograph." Although I searched for it diligently ever since, now quite twelve years, I failed to find it again until the last week in September of this year (1893), when I had the good fortune to discover it in fairly large numbers and in prime condition near the same locality where I had met the first example, namely, in a marsh pool between Blairgowrie and Dunkeld, in Perthshire, N.B., perched on confervoid filaments attached to *Utricularia vulgaris*, and on the rootlets of *Lemna*.

The most remarkable peculiarity of *F. cucullata* consists in the shape and structure of the corona, the large dorsal lobe recalling to mind a monk's cowl, and resembling in this respect the corona of *F. Hoodii*, but minus the long sleeve-like, flexible processes characterizing this species. It has, however, two very short processes on the back of the dorsal lobe, greatly resembling the pimples of antennæ (Fig. 2), but bearing no

setæ, and therefore probably not representing sense organs. These pimples give a very characteristic appearance to the creature when seen in front view, Fig. 2. The two smaller ventral lobes are as shown in Figs. 1 and 2.

When the animal contracts its head, the dorsal lobe folds inwards first, and the two ventral lobes overlap it, leaving a brush of setæ projecting on either side, which finally are also drawn into the cup. In expanding the ventral lobes appear first; then the dorsal lobe moves out very slowly, the creases disappearing very gradually; then suddenly the lobe flops out in cowl-shape.

The long, straight, stiff setæ forming the outer rows stretch out and radiate in all directions; the very small setæ of the inner row are also straight and stiff, and prevent the escape of the small organisms which have made the fatal mistake of entering this alluring flowerlike cup.

The semi-circular wreath of vibratile cilia at the bottom of the vestibule is difficult of observation, owing to the condition of the skin; there are, namely, a profusion of moveable greyish granules floating in the fluid between the outer and inner membrane of the skin that rush backwards and forwards in definite channels at every movement of the animal, and render the corona and anterior part of the body rather opaque. These granules are more or less present in all floscules, but more conspicuously in *F. ambigua*, *F. algicola*, and *F. cucullata*.

The coronal cup is very deep and the body elongated in shape and constricted in the middle, forming an elegant waist.

I have failed to find lateral antennæ, but Mr. Dixon-Nuttall has observed a single antenna on the dorsal side of the neck in specimen sent to him. Lateral canals and vibratile tags are present, but I have not been able to find a contractile vesicle. The remainder of the anatomy is quite normal and requires no further remark.

The animals inhabit large, clear, transparent tubes which are fixed with marked preference to small filaments of a parasitic alga, when larger leaflets were present in abundance.

I had the good fortune to see a *male* hatched, which has the peculiarity of possessing a prominent dorsal antenna, as seen in Fig. 3; all other males of Floscules, so far as observed, having no such antenna; it has also two small eyes close together.

I have observed the three kinds of eggs in the hyaline tubes of *F. cucullata*, the ordinary female (parthenogenetic) summer eggs, the male eggs, which are smaller and rounder, and the winter or resting eggs, which are larger and denser, and furnished with a double shell.

I am greatly indebted to Mr. C. F. Rousselet for the drawings from nature, both of the ventral and side views, illustrating this paper.

Length, total, $\frac{1}{24}$ to $\frac{1}{20}$ in., of body alone $\frac{1}{70}$ in.

Habitat, Marsh pool near Blairgowrie, Perth.

Explanation of Plate.

Fig. 1. *Floscularia cucullata*, side view.
„ 2. „ „ anterior part, front view.
„ 3. „ „ the male.

On Cysticercus quadricurvatus (Rosseter).

By T. B. Rosseter, F.R.M.S.

(Read November 17th, 1893.)

Plate XVII.

Form of cyst, lenticular; long axis, 0·220 mm.; breadth, 0·182 mm.

Hooks, 10; length, 0·028 mm.

Habitat, *Cyclops agilis.*

Locality, Mr. Gardner's Pond, Bekesbourne, near Canterbury.

Found December, 1892.

Among numerous *Cyclops agilis* taken from Mr. Gardner's pond, in the parish of Bekesbourne, and which were the hosts of the cysticercoids of *Tænia tenuirostris—T. sinuosa*, *T. gracilis*, and *T. coronula*—was one which gave shelter, or rather was the resting-place of the above-named Cysticercus.

It was situated between the second and third segments of the dorsal region, that is to say, just below the stomach. When dissected out the cyst (Fig. 1) was lenticular in its formation, its long axis being 0·220 mm. and its breadth 0·182 mm. The future scolex was in an immature condition, and the suckers were quite indefinable. The parenchymatous tissue within the cyst contained numerous fatty globules, and a very few, abnormally so, of what Dr. O. von Haman calls chalk bodies. The depth of the fluid cavity or chamber was 0·005 mm. The caudal appendage was short, and I failed to find on it the six hooks of the oncosphere.

The rostrum of the rudimentary scolex carried ten hooks, whose length was 0·028 mm., root 0·016 mm., hook 0·012 mm., and they are very remarkable in their formation. Taking the whole length of the hook at its back portion it consists of four

very symmetrical curves, two concave and two convex. The posterior root commences with a very sharp point, then gracefully curves inwards (concave) and outwards (convex), again becoming concave opposite the anterior and convex to form the claw of the hook, which also terminates with a sharp point. The claw is not unduly or sharply curved, and a parallel line can be drawn from the tip of the posterior root to the termination of the claw. The facial portion of the root, where the anterior root commences, thickens considerably posteriorly, and, continuing to do so, forms the root. But this facial portion of the root is not sharp or rounded, but squares off at a right angle, the anterior portion gracefully curving inwards to form the claw (see Fig. 3).

The hooks are placed on the rostrum back to back (see Fig. 2), a remarkable circumstance, so that when in its mature condition it is in the intestine of its final host it buries its scolex, together with its elongated proboscis and rostrum, in the villi of the mucous membrane of the duodenum. The claw has to be raised to a given angle to give the hooks a firm grip of the tissue, so as to prevent expulsion during the passage of the triturated aliment from the gizzard, which, together with the digestive juices, is poured into the duodenum. This would cause the hooks, as far as their claw is concerned, to be considerably elevated. To enable them to be so the radial muscles of the bulb of the rostrum, which not only encircle the rostrum but are likewise attached to the posterior root, are considerably expanded. This expansion is brought about by the contraction of the longitudinal muscles, which run the whole length of the proboscis down into the scolex, from whence the momentum would be received, and which, like the radial muscles, are attached to the posterior root; the concave portion over which the longitudinal muscles lap rests on the base or crown of the bulb of the rostrum. This action of the longitudinal muscles must, in consequence of the formation of the root, cause a depression of the crown of the rostrum. The depth of this depression depends on the elevation of the hooks, and when they are fully elevated the radial muscles are stretched to their utmost; on the contrary, when they are depressed the muscles are brought back to their normal position.

The question will naturally be asked—How, if an adult

Tænia of this particular Cysticercus is up to the present time unknown, these conclusions have been arrived at?

The above observations have been made and conclusions arrived at from the following facts: Care was taken in causing the expulsion of the formative substance within the cyst. This having been obtained by the nitric acid process, a matter of some delicacy owing to the immature scolex being deeply seated within the cyst, a better opportunity was afforded to study the formative substance and the hooks. But little can be said of the former owing to the homogeneity of the substance, the emitted contents being seemingly a mass of plasma (see Fig. 4), only that the application of ether by dissolving the minute fatty globules gave the opportunity of differentiating the tissues of the rudimentary rostellum. A searching examination with a $\frac{1}{8}$ revealed the fact that amongst this homogeneous mass was a tract of fibrous tissue (Fig. 4*a*). This tract was quite distinct from the surrounding granular substance which would have constituted the embryonic scolex of the Cysticercus or future Tænia, and it ran upwards and curved round until it reached the aggregated dense mass on which the hooks were situated—the future rostellum—where it was lost to view.

The position of the hooks as well as their formation in this, the cysticercoid, is exactly the same as that in the Tænia stage, and it is from this circumstance that one is enabled to determine their position in the mature scolex, as well as the species of Tænia to which the Cysticercoid will, when transferred to its final host, become the perfect scolex with its fertile proglottides.

I have invariably found that when the expelled rudimentary scolex is compressed, either with a lever compresser or under a cover glass with needles, the hooks are expanded to their utmost limit, and when the pressure is taken off they revert again to their former position, but if pressure is insisted on they instantly become separated in all directions. Such, however, was not the case in this instance, for apply what pressure one would they did not separate, but seemed welted or bound together back to back by some ligamentous process. Advantage was taken of this phenomenon to further explore the somewhat indefinite termination of the muscular tract, and to

elucidate its possible connection with the hooks and the radial muscles of the rostrum.

Such delicate objects as these which have been treated in media under a cover glass, and whose length in this instance was 187 μ, and 125 μ broad, require careful manipulation in exploring them; teasing such a minute particle, or rather portion, of tissue with needles is entirely out of the question, and raising the cover-glass meant one of two things, either floating away of the object or disintegration of the specimen. Accordingly the glycerine was withdrawn, and then water acidulated with acetic acid allowed to flow gently under the cover-glass, sufficient pressure being applied to keep the ruptured cyst and tissue from floating out. This added fluid was also drawn off and a thin film of acidulated glycerine allowed to run in and take its place. Sufficient time having been allowed for the acid medium to permeate the substance pressure was again employed. The hooks which hitherto had resisted the separation now expanded in an upward direction, being driven on either side by pressure upon the cover-glass the points of the posterior root bending together, then suddenly separating from each other, finally dropping into a vertical position, but remaining contiguous to each other, back to back, as if the substance which had hitherto held them was stretched out of its normal length, or had been loosened. Pressure was still kept on the cover-glass, and the superfluous glycerine being removed, a film of carbolized gelatine run round edge of cover-glass; when this was dry a coating of Bell's cement was applied to keep the cover-glass from springing.

Simple as this process may seem, the object in view was attained, for, with the aid of a $\frac{1}{16}$ immersion, the hitherto obscure and abruptly-terminating fibrous tissue was traced further on, finally spreading itself like a fan (Fig. 4*b*). In its normal condition it would have run upwards over the convex face of the rostrum, uniting itself with the radial muscles at their point of attachment to the hooks. From the position of the hooks on the embryonic scolex within the cyst it is possible by analogy to sketch out or delineate the mature scolex. In this instance I should be inclined to hold the opinion that the scolex when discovered in its final host will be of an elongated form with a narrow attenuated neck; that the suckers would

be strong and muscular; that when the hooks are extended a depression will be formed by the pressure of the posterior roots on the crown of the rostrum, but whether the rostrum will be seated on an elongated or on a short proboscis it is at this stage impossible to say.

There were no markings or indentations on the hooks, such as are invariably found in the neighbourhood of the upper portion of the hook, near the anterior root. This, according to Leuckart, shows that the hooks have attained their growth and strength by successive layers of carbonate of lime. Leuckart's suggestion would account for the small number or absence of the chalk-bodies, which are usually so abundant in the cysts of other Cysticerci, they having been absorbed at this early period in the maturing of the hooks.

In the majority of cases during the process of simmering with nitric acid the subcuticular membrane collapses and hangs as a bag or covering within the cyst, and is usually evaginated with the embryonic scolex. But in this instance, when the cuticle of the cyst was ruptured by the pressure applied to the cover-glass, after the emission of its contents the hard cuticle broke off, leaving the hypodermis perfectly intact, as it does when forming the boundary wall of the fluid cavity or vitelline membrane of the embryonic scolex (Fig. 6). Dr. O. von Haman supposes that the hypodermis goes to form the neck of the mature worm. Whatever change may take place in this respect on the reception of the Cysticercus into the duodenum of its final host is at the present time a matter of conjecture; still, truth leans towards his suggestion for this reason: "Cysticerci which have been injected twenty-four hours previous to death of their host have been found, when taken from the duodenum, to have evaginated themselves, and the scolex and neck to have been perfectly formed, but no trace of the formation of proglottides at the base of the neck has been seen. This has been my experience gained from post-mortem examination of the viscera of ducks, which I have myself experimented on by injection."

Neither Dujardin, Davaine, Cobbold, nor Leuckart in their works on Tænia of Man and Animals, or Krabbe, who in his Monograph and Supplement enumerates 138 species of tapeworms belonging exclusively to birds, make any reference or give any drawings of a Tænia whose rostrum bears hooks

analogous to those of the organism I have described above, and, therefore, I have come to the conclusion that this Cysticercus is that of a hitherto undiscovered tape-worm.

In order that the tape-worm from this Cysticercus may be recognized I propose to give it the name of *Cysticercus quadricurvatus*, Rosseter.

Explanation of Plate.

Fig. 1. *Cysticercus quadricurvatus* taken from body cavity of *Cyclops agilis*, × 400.

,, 2. Bundle of hooks to show the position on rostrum, × 1,500.

,, 3. Single hook, detached to show formation, × 1,500.

,, 4. Contents of cyst emitted by action of nitric-acid with muscular tract, × 300

,, 5. Muscular tract of same, × 600.

,, 6. Ruptured cyst with subcuticular membrane intact, × 180.

List of Diatomaceæ Observed in Gathering from the River Lea.

By E. Grove, F.R.M.S.

(*Taken as read January 19th, 1894.*)

Achnanthes inflata (Ktz.), Grun.; scarce.
,, *minutissima* (Ktz.), Grun.; scarce.
Amphora ovalis, Ktz.
,, ,, var. *affinis*, Ktz.
,, ,, var. *Pediculus*, Ktz.
Campylodiscus hibernicus, Ehr. (*C. costatus*, Sm.).
Cocconeis Pediculus, Ehr.
,, *Placentula*, Ehr.
Cyclotella antiqua, Sm.; scarce.
,, *operculata*, Ktz.; scarce.
Cymatopleura apiculata, Sm. (doubtfully distinct from *C. Solea*).
,, *elliptica*, Sm.
,, *parallela*, Sm.
,, *Solea*, Sm.
Cymbella anglica, Lag.
,, *æqualis*, Sm.; scarce.
,, *Cistula*, Hemp.
,, ,, var. *maculata*, Ktz.
,, *Ehrenbergii*, Ktz.; scarce.
,, *gastroides*, Ktz. (*C. aspera*, Ehr.)
,, *helvetica*, Ktz.
,, *lanceolata*, Ehr.
,, *obtusa*, Greg.
,, (*Encyonema*) *cæspitosum*, Ktz.
,, ,, *prostratum*, Ralfs.
,, ,, *turgidum*, Greg.
Diatoma vulgare, Bory.

Epithemia Argus, var. *amphicephala*, Grun. (*E. alpestris*, Sm.); scarce.
Epithemia gibba, Ktz.
,, *Hyndmanii*, Sm.; scarce.
,, *turgida*, Ktz.
,, *Sorex*, Ktz.
,, *Zebra*, var. *proboscidea*, Grun.
Eunotia Arcus, Ehr.
,, ,, var. *bidens*, Grun.
,, *flexuosa*, var. *bicapitata*, Grun. (*Syn. Biceps*, Sm.).
,, *gracilis*, Ehr.; scarce.
,, *incisa*, Greg.
Fragilaria capucina, Desm.
,, *Harrisonii*, Sm. (*Odontidium*), Sm.
,, *mutabilis*, Sm.
Gomphonema acuminatum, Ehr.
,, ,, var. *Brébissonii*, Ktz.
,, ,, var. *elongata*, Sm.; scarce.
,, *constrictum*, Ehr.
,, ,, var. *capitata*, Ehr.
,, ,, var. *subcapitata*, Grun.; scarce.
,, *cristatum*, Ralfs. (doubtfully distinct from *G. Augur*, Ehr.).
,, *curvatum*, Ktz.; scarce (*Rhoicosphenia curvata*, Grun.)
,, *exiguum*, Ktz., scarce.
,, *geminatum*, Ag.
,, *gracile*, Ehr. (var. *aurita*, Brun ?); scarce.
,, *intricatum*, Ktz.; scarce.
,, ,, var. *Vibrio*, Ehr.; scarce.
,, *parvulum*, Ktz.; scarce.
,, *subclavatum*, Grun.
,, *subtile*, Ehr.
,, *Turris*, Ehr.; scarce.
Mastogloia Smithii, var. *lacustris*, Grun.
,, *elliptica*, var. *Dansei*, Thw.; scarce.
Melosira crenulata, Ktz. (*Orthosira orichalcea*, Sm.).
,, *distans*, var. *nivalis*, Sm.; scarce.
,, *varians*, Ag.
Navicula alpestris, Grun.; scarce.

Navicula ambigua, Ehr.
" *amphigomphus*, Ehr.; scarce (*N. iridis*, var.).
" *amphirhynchus*, Ehr.; scarce.
" *anglica*, Ralfs. (*N. tumida*, Sm.).
" *bacillaris*, Greg.
" *Bacillum*, Ehr.; scarce.
" *binodis*, Sm.; scarce.
" *cryptocephala*, Ktz.
" *Crucicula*, Sm.; scarce (*Stauroneis*, Sm.).
" *cuspidata*, Ktz.
" *elliptica*, Ktz.
" *gracilis*, Ehr. (*Colletonema neglectum*, Thw.).
" *Hebes*, Ralfs.
" *hungarica*, Grun. (*N. humilis*, Donkin).
" *lanceolata*, Ktz.
" *latiuscula*, Ktz. sc.; small form (*N. Patula*, Sm.).
" *limosa*, var. *gibberula*, Ktz. (*N. gibberula*, Ktz., Sm.).
" *Pupula*, Ktz.; scarce.
" *radiosa*, Ktz.
" *Schumanniana*, Grun. (*N. Trochus*, Ehr.).
" *sculpta*, Ehr. (*N. tumeus*, Sm.).
" *tuscula*, Ehr. (*Stauroneis punctata*, Sm.).
" *viridula*, var. *slesvicensis*, Grun.
" *vulgaris*, Thw. (*Colletonema*, Thw.).
" *(Pinnularia) Cardinalis*, Ehr.
" " *hemiptera*, var. *interrupta*, Cl.
" " *Legumen*, Ehr.; scarce.
" " *major*, Ktz.
" " *mesolepta*, var. *stauroneiformis*, Grun.
" " *nobilis*, Ehr.; scarce.
" " *oblonga*, Ktz.
" " *stauroptera*, var. *interrupta*, Grun.
" " *stomatophora*, Grun.; scarce.
" " *viridis*, Ktz.
" *(Stauroneis) Phænicenteron*, Ehr.
" " *Smithii* (*St. linearis*, Sm., *Pleurostauron Smithii*, Grun.)
Nitzschia amphibia, var. *acutiuscula*, Grun.; scarce.
" *Denticula*, Grun. (*Denticula obtusa*, Sm.).
" *Heufleriana*, Grun.

Nitzschia linearis, Sm.
„ *palea*, var. *tenuirostris*, Grun.; scarce.
„ *recta*, Hantzsch ?
„ *sigmoidea*, Sm.
„ *sinuata*, Grun. (*Denticula*, Sm.).
„ *vermicularis*, Hantz.
„ (*Hantzschia*) *Amphioxys*, Grun. (*Nitz. Amphioxys*, Sm.).
„ „ var. *elongata*, Grun.; scarce.
„ (*Tryblionella*) *angustata*, Sm.
„ „ *apiculata*, Greg.
„ „ *gracilis*, Sm. (*Nitz. Tryblionella*. *Hantzsch*, Grun.).
„ „ *levidensis*, Sm.; scarce.
Pleurosigma acuminatum, Ktz. (*Pl. lacustre*, Sm.).
„ *attenuatum*, Sm.
„ *Spencerii*, Sm.
Surirella angusta, Ktz.
„ *bifrons*, Ktz. (*S. turgida*, Sm. ?).
„ „ small forms (perhaps *S. linearis*, Sm., vars.).
„ *biseriata*, Bréb.
„ *elegans*, Ehr.
„ *minuta*, Bréb.; scarce.
„ *ovata*, Bréb.
„ *robusta*, Ehr. (*S. nobilis*, Sm.)
Synedra capitata, Ehr.
„ *pulchella*, var. *gracilis*, Sm.
„ „ var. *Smithii*, Ralfs.
„ *splendens*, Ktz.
„ *Ulna*, Ehr.
„ „ var. β, Sm.
Tabellaria fenestrata, Ktz.
„ *flocculosa*, Ktz.

PRESIDENT'S ADDRESS.

By Edward Milles Nelson, F.R.M.S.

(Delivered February 16th, 1894.)

Gentlemen,—I thank you for the renewed confidence you have shown in me by again electing me your President.

You have just heard the report of your Committee on the work of the past year. In quantity it is not behind that of previous years, while in quality it undoubtedly shows an advance. If, for instance, those who possess the complete Journal of this Club will compare the plates in the later numbers with those of former years they cannot but notice a marked improvement in the drawing of microscopical objects, and the next number, which will shortly be in your hands, will confirm this more strongly.

Not only is there finer detail depicted than formerly, partly owing, no doubt, to the improvement in the optical and mechanical portions of the instrument, but the drawings are more finished, and more time is evidently expended over them. What applies to the drawings applies also with even more force to microscope work in general and to the papers.

Every year original work becomes harder, and microscopical discoveries more difficult. There was a time when an afternoon with a $1\frac{1}{2}$ inch objective would, perhaps, reward the observer with four new species, but that day is past, and discoveries now lie among the higher powers. Dr. Carpenter's low-angled $\frac{1}{4}$ for penetration, which he worked after the manner of an inch, was also played out, and the professorial staff of the medical schools would now scorn to use an instrument which a few years back they declared to be "good enough for histological purposes which did not need any improvement."

Anyone who remembers the kind of instruments exhibited here in former years will notice the change that has taken place, and I make bold to state that there is no body of micro-

scopists in the world that can bring forward such a display of first-class microscopes as the members of the Quekett Microscopical Club. Probably they will not be covered from the top of the eye-piece to the bottom of the foot with arcs graduated on silver, but they will possess a steadiness and smoothness of motion that will enable them to perform work of the highest power with efficiency.

It is a fact that the evolution of what may be called the advanced students' microscope has taken place at this Club.

On the one hand we did not give ourselves away in rapturous praise of the continental microscope, which after a few years had to be remodelled in all important movements, neither on the other hand did we run riot in the swinging substage and turning inside out abominations. But instruments of a sound construction, built on a good scientific design, have first been brought out here, and are constantly used and exhibited by the members of this Club. By this statement it is not intended to imply that all recent improvements in the microscope have been the inventions of our members, far from it, but it does mean that some instruments, whose introduction had been received with acclamation, were here regarded with disfavour.* Time has fully justified the correctness of our opinions, as those instruments have disappeared for ever. The three forms of advanced students' microscopes at the present day are, in the order of their introduction, Swift's vertical lever, Baker's direct acting differential screw, and Watson's horizontal lever. All these three types are sprung throughout, have tripod feet, and are made in every condition of completeness, from those of the simplest kind to those having full mechanical movements. One of the latest additions to the microscope is a most useful one, and that is a rack work draw tube; the draw tubes of these instruments have been so much improved that the same microscope will work both long and short tube lenses equally well. Two of Messrs. Swift and Son's new elementary students' microscopes have been exhibited here since the vacation; both these instruments have tripod stands of the Powell pattern, viz., a horse-shoe resting on a tripod. When the microscope is placed in a horizontal position the limb rests on the

* This Journal, 1883, Vol. i., s.s., p. 324.

back of the horse-shoe; this constitutes an ingenious and novel feature.

During the past twenty years a change for the better can be noticed in the box of apparatus. It has got smaller and smaller until it has entirely disappeared. Perhaps a little too much has been improved away. For instance, for opaque objects there has been no illuminator invented that will compare with the lieberkühn; a complete outfit, therefore, should have lieberkühns with all powers from two inches to a half inch. Of course, it will be said that a side reflector serves all the purposes of a lieberkühn, and that one piece of apparatus is better than several. It is very true that a side reflector can be used with the lower powers, but hardly with a half-inch, unless its aperture be very low; besides this, the question of all round illumination as against that on one side only is opened up.

With this improvement in the box of apparatus it is to be feared that one little thing has been forgotten, viz., that a single substage condenser is insufficient for all kinds of work. Two are necessary, one for high powers, which should itself be at least of quarter-inch power and wide in angle, the other a low power, more moderate in angle, with stops, etc., for dark ground illumination; the upper lens of this condenser should be removable, so that the lower lenses may be used for very low power work.

The substitute for these two condensers is found in a wide angled low power condenser, which is too low in power, and too full of spherical aberration, for high power work, too high in power for low power work, and which really is only suitable for objectives of medium power, such as half-inch to quarter-inch. It reminds me of a pocket bath that was advertised some years ago, which was bad for the pocket and useless as a bath. So also a single condenser is good neither for high nor for low power work.

It is to be feared that a serious danger is likely to occur to the "microscopy" of the future, owing to the neglect of viewing opaque objects with a stereoscopic binocular. Personally, I do not believe that any observer, however eminent, who has not previously passed through the special training of viewing opaque objects with a stereoscopic binocular, can form correct ideas of the shape of objects solely by alterations of focus. This is such an important subject that the necessity for some such training

ought to be strongly impressed on every beginner. If you show a fairly large diatom such as *Heliopelta* or *Aulacodiscus formosus* or *Kittonii* to one only acquainted with the estimation of depth by means of the fine adjustment with a monocular, and if you let him form his own conclusions as to the shape of the object, with which he should not be previously acquainted, and afterwards show him the same object as opaque, with a stereoscopic binocular, he will receive a terrible shock as the truth dawns upon him that, although he has been a microscopist for many years, he has never rightly comprehended the true form of a single object he has ever examined.

If to-night there are here any beginners in microscopical work, let me earnestly advise them to render any such shock impossible by a timely study of opaque forms with a binocular; but if there are amongst us any advanced microscopists who have not as yet prosecuted this form of research, let me urge upon them to enter at once upon a similar course of study, and so render the shock less than it would be if it were to come in subsequent years. Leaving the mechanical, we will pass on to the optical portion of the microscope; here we find continuous advances in that important branch, viz., cheap objectives.

Although the aperture of the cheap oil $\frac{1}{12}$ remains much the same, viz., 1·25—1·30 N.A., the corrections for both the chromatic and spherical aberrations have undergone considerable alterations. The changes in the chromatic aberrations will be the more noticeable, as those violent purples and reds with which we are all acquainted are gone, and now are replaced by far paler tints. It is said that some of these lenses have been corrected for photography; this, in the fullest sense, means that a photograph will be true to the visual focus with an ordinary plate, when no screen is employed. I have not as yet experimented with the most recent objectives in this direction, but the statement that those of a year or two back were so corrected cannot be maintained if other than the narrowest angled cones of illumination were used. Nevertheless we have all seen the fine results lately obtained by Mr. Smith with cheap objectives on isochromatic plates, one taken with a new lens by Messrs. Swift and Son being specially noticeable. The improvements in the high powers, indicated above, have also been carried out with marked success in the medium

powers from $\frac{1}{6}$ to $\frac{1}{3}$ inch. Having personally examined a large number of the following examples of this class I can speak most highly of their performance.

No. 6 Reichert ($\frac{1}{6}$)	...	·82 N.A.	...	O.I.* 13 7
No. 7 Leitz ($\frac{1}{4}$) ...	...	·71 N.A.	...	O.I. 17·7
8 m.m. Reichert ($\frac{4}{10}$)	...	·447 N.A.	...	O.I. 18·6

Of the low powers, 1 to 2 inch, one cannot speak so favourably; it would seem that, with the single exception of the Zeiss a.a. ($1\frac{1}{8}$) N.A. ·19, O.I. 21, which is a very fine lens, they had been altogether neglected, probably because medical students are large buyers of these lenses, and any low power, a French button, for instance, is "good enough for histological purposes." But there is another large class of workers, especially in this Club, to whom good cheap low powers, such as a 1 inch and $1\frac{1}{2}$ inch, would be invaluable for the examination of pond life. A good criterion for a $1\frac{1}{2}$ inch is the delineation of the cilia on a volvox globator. Of course a dark ground must be used. We ought, therefore, to encourage as far as possible the semi-apochromatization of low powers.

With regard to eye-pieces nothing recently has taken place. The most comfortable eye-pieces for general work appear to be the 12-power compensating for the long tube, and the eight power for the short, both being of the positive form.

Projection eye-pieces present greater difficulties; the best, it would seem, are constructed of a glass which crystallizes, and those made of a durable kind of glass do not yield such sharp images. Perhaps greater care is required in the technical manufacture of these eye-pieces than is usually bestowed upon them, for the fact remains that it is by no means easy to get a good projection eye-piece.

The substage condenser comes last, but by no means least, in importance. We have all been told that the achromatization of the substage condenser was an unnecessary refinement, but that, however, has not been the opinion here, and the substage

* O.I. means "Optical Index;" it is the numerical aperture of the objective multiplied by 1000, and divided by the initial power. The ideal O.I. for a microscope objective is about 25. A true $\frac{1}{2}$ inch of 60° affords an excellent example. Powell's apochromatic $\frac{1}{4}$ has an O.I. of 23, and his $\frac{1}{80}$ an O.I. of 1·7; the smallness of the O.I. of the latter shows at once the fallacy of its construction. The opposite error is exhibited in American $\frac{2}{3}$ of 80°, which some years ago were thought a great deal of; they would have an O.I. of 43 ("Journal R.M.S.," 1893, p. 12).

condenser has been apochromatized by Mr. Powell by the employment of fluorite lenses. The result of this is that objectives can be illuminated by larger solid axial cones than was possible before. As the Abbe condensers have been discussed above we will pass on to a somewhat later development of microscopical technique, viz., monochromatic illumination and screens. Monochromatic illumination for the microscope, though a very old idea, being first suggested by Sir D. Brewster (circa 1836), has lately come into special prominence. He proposed three methods—first, a monochromatic lamp; secondly, absorption media, both by fluids as well as by glasses; thirdly, a prism. The intention at that date was to obviate the necessity for achromatism in the objective. The objectives he used were his own grooved sphere, and Herschel's doublet of no aberration. To what a length this notion was pushed the following passage will show:—"A solar telescope should never be an achromatic one, but should consist of a compound lens of no aberration, all the colours of the spectrum but one being absorbed by the darkening glass." It is also curious to note that a monochromatic red band was selected as being the most suitable.

Dr. Goring (1837) severely criticises Brewster's article. He says that monochromatic light, even when obtained by means of a prism, permits dispersion phenomena to be observed when the light is oblique for the resolution of lined tests; he also says that he prefers blue light. His term monochromatic is not used in so strict a sense as we should use it. He evidently means a broad band of approximately one colour; this would fully account for the dispersion phenomena he observed. But at the present time the intentions underlying the use of monochromatic light are quite different to those quoted above. They are five in number. First, the increase in the effective aperture of the objective by the shortening of the wave length; secondly, the sharpening up of the image by the removal of the spherical aberration of the chromatic difference; thirdly, the rendering of colours that would prove refractory in photomicrographic work neutral; fourthly, the rendering of the visual and actinic foci identical; fifthly, the subduing of the intensity of the light for visual purposes when large cones of illumination are employed.

The means now used to obtain monochromatic light are, with the exception of the lamp, much the same as in 1836. For purposes (1) and (2) I have found nothing better than my own modification of the prism apparatus, but for (3) and (4) glasses and fluids are more suitable, as they are inexpensive and handy to use. For (5) there is nothing better than a glass of a certain depth of peacock green cemented to a glass of a certain depth of cobalt blue. The objections to the prism are its cost, great size, and want of uniformity of tint throughout the field, but for visual work this last objection need not be considered. Absorption media are now largely used, and as they undoubtedly have an important future before them, a short time must be devoted to them before we pass on.

The screens of Sir D. Brewster were monochromatic red; those of Dr. Woodward were ammonio-copper, blue, but not monochromatic; next we have Professor Zettnow's mixture of sulphate of copper and bichromate of potash, giving monochromatic yellow green; then we have his monochromatic violet screen, which is composed of two fluids, one a solution of iodine in chloroform, the other being ammonio-copper. But quite recently we have had two new screens introduced, viz., a methylen blue by Mr. Lovibond, and a malachite green and picric acid by Mr. Gifford. Neither of them is monochromatic; the methylen blue cuts out a broad band extending from the upper red to the yellow green; it passes, therefore, infra red, green, blue, and violet. Photographically the infra red has no effect, and this screen is very suitable for purpose (3); visually the infra red is of no importance, and as its colour is a bright blue it is very pleasant to work with. The cutting out of the most powerful of the interfering rays, such as the upper red, orange and yellow, renders this screen admirable for purposes (1) and (2).

Mr. Gifford's green screen gives wider bands than the methylen blue, for it cuts out the upper red, orange, yellow, violet, and part of the blue; it passes, therefore, infra red (a trifle more than the methylen blue), green, and a little blue. For photography with this screen plates should be sensitive for the portion of the spectrum near the F line. The remarks on the methylen blue screen are equally applicable to this. Mr. Gifford uses these screens in a highly concentrated form, so that

a thin film, which can be mounted on an ordinary microscope slide, is sufficient for all purposes; this ingenious plan of his obviates all necessity for bottles and troughs.

Illuminants for the microscope remain much the same; the common paraffin lamp is still the best for visual work, and, both on account of its cheapness and steadiness, it is now being more and more used for photomicrography; at the same time it can hardly be said to be displacing oxy-hydrogen for that purpose. Daylight, though very largely employed on the Continent, is not so much used in this country as formerly.

Many attempts have been made to employ the electric light for microscopical work, but the image of the hot filament does not seem suitable for the purpose. The arc, however, is with advantage used in the projection microscope.

Concerning accessory apparatus, there is not much to note. Photomicrography is steadily gaining ground, both for micrometry and for the delineation of objects; it is probably owing to this that no new cameras, or micrometers have appeared.

There are one or two exceedingly simple yet very practical little devices, which, although invented some years ago, are to be seen, neither at the opticians, nor on microscopists' tables. They have only to be known to be thoroughly appreciated. Taking them in the order of their publication, the first is Burch's micrometer.* This consists of a cap fitting over the eye-piece, and containing either a neutral tint, or a silvered diagonal with a hole in it. At right angles to this cap is a light wooden rod, 10 inches long, holding a paper scale. As you look through the cap you see the object through the eye-piece, and at the same time the image of the scale reflected on it; this is a useful, accurate, and yet the simplest micrometer ever designed. Another form of this instrument consists of the same cap with a large mirror on an arm, at right angles to the cap; this is now known as the Abbe camera, but priority of invention and description belong to Mr. Burch. The second device is Michael's polarizer,† which consists merely of a piece of opalescent glass fitted over the mirror. As spar prisms have become expensive of late years, such a cheap and efficient substitute will be heartily welcomed. The

* This Journal, Vol. v., p. 45, 1878.

† This Journal, Vol. i., s.s., p. 323, 1883.

third device is one to which your attention has been called before. A diagonal piece of looking-glass is fitted in an eye-piece cap, the microscope placed in a horizontal position, and the image projected on a piece of paper, where it can be drawn without the necessity of looking through the microscope, camera, or other apparatus at all.

With regard to the theory of the microscope I am glad to be able to report that the views expressed here in connection with the diffraction theory have been accepted *in toto*. You will never again hear of the futility of the microscopical examination of the *P. angulatum*, or of the stopping out the useless central beam, or the prediction of intercostals solely from the consideration of first order spectra, or that diffraction begins at ·01 mm.

The review of the microscopical work in my own department during the past few years is now finished, and, therefore, that which may be termed the official part of my address is closed; but as it has been the growing practice to shorten these presidential reviews and supplement the address by some original work, my photomicrographic apparatus, which has not been exhibited or described before, is brought for your kind inspection this evening. During my microscopical career, of which this is the 24th year, it has been my earnest endeavour, by work and long acquaintance, to understand as far as possible any instrument or theory before writing about it. Such a line of conduct is not in keeping with the procedure of the present day. Now a man (he cannot be called either a worker or an observer) buys a microscope, and a fortnight afterwards writes a book upon the subject, an article or two in the periodicals from the same pen having appeared in the interval. Bad as this is among ourselves, it is as nothing in comparison to that which goes on in the photographic world. The injury caused by this system is considerable, because it often happens, especially in periodicals, that an extremely valuable paper does not receive the attention it deserves, on account of the vast accumulation of rubbish by which it is surrounded. This, however, is a digression. But to return to our subject, I began photomicrography upwards of ten years ago, consequently before the advent of apochromatics. The apparatus then made from my design was not precisely similar to any published

form, though in the main it followed that of Dr. Woodward; as it has long since been broken up, you will not be wearied with a description; it need only be said that the work was carried on in the dark room, there being no camera of any description. For simplicity and ease of adjustment, this method of Dr. Woodward's has no rival, nevertheless, as is the case with all good things, there is a "but," which is, but you require one if not two rooms devoted to it, and to nothing else, conditions which are not always obtainable. Suffice it to say that after some work, not one, but a whole comedy of errors was found in the design, so it was broken up and another made. The second differed from the first, inasmuch as the microscope and the plate holder were supported, not on separate trestles, as in the first, but on a plank which rested on a table. Paraffin now took the place of oxy-hydrogen, and like it was enclosed in a dark lantern, no camera being used. Work performed with this apparatus showed me that in some respects it was better than its predecessor, and in some respects not so good.

The photographic part of the work, though crude in the extreme, for at that time I had never done any ordinary photography, was improving, but all my negatives, taken with high powers and large axial cones of light, were failures. However, with low powers, and medium powers with small cones of illumination, and high powers with oblique light striæ resolutions, better success was obtained. The great difficulty, which could not be overcome, was an indistinctness of image sufficient to blot out all detail when large cones of illumination were employed. Displacements of foci, correctors at the back of the objective, ammonio-copper cell, were tried in vain; the details, which with the microscope were visible to the eye, were still invisible on the plate, and so I gave up photomicrography. Fair pictures of the *A. pellucida*, and of the old exclamation marks on the Podura scale, were obtained, but anything like secondary structure, or fractures through secondaries, were blotted out. The isochromatic principle, if discovered at that time, was quite unknown to me. Perhaps further work might have secured better results, and, photographically speaking, it would have undoubtedly done so, but not until it was proved that the main error lay in the objective was the work given up.

We will now pass on to 1886, the date of the introduction of the apochromatic objective, all the old difficulties and impossibilities were at once dispelled, and anyone who took the smallest interest in the matter could see that there was a glorious future for photomicrography. My apparatus was once more set up, and without difficulty results were obtained which surpassed the most sanguine expectations of former years.* However, it was not long before it became evident that number 2 apparatus was, as hinted above, unsuitable for the work. It was, therefore, condemned, and number 3, which is now before you, was designed.

You will at once see that in its broad outline it is a combination of the first and second, inasmuch as the board and the trestles are both retained. The trestles are both alike, and of the common tripod form, the board is of teak, very massive, being 8ft. by 1ft.; the upper surface is perfectly smooth, but not polished.

The feet of the trestles rest on blocks of cork, and slabs of cork are placed between the board and the trestles. From each table between the legs of the trestles hangs half a cwt., and underneath the board hang four quarter cwts. This weight gives great stability to the whole apparatus. A bolt passes through the board and the top of the trestle—this should not be screwed up, but left quite loose. The height of the top of the board above the ground is 4ft. $\frac{1}{2}$in.; this has been adjusted to my own height of 5ft. 10in.

Nothing except the focussing rod passing down one side of the board, with its corresponding pulley on the other side, is fixed to the board.

We now come to a distinct difference between this and the former designs, viz., the presence of a camera. By camera is meant the dark chamber which connects the eye-piece of the microscope to the dark slide, for this camera is not at all like any ordinary camera, because the bellows are replaced by rectangular mahogany tubes ($6\frac{3}{8} \times 5\frac{5}{8}$ outside measure), capable of being joined up in any order. There are also two troughs, each 3ft. long, made of mahogany, stoutly built and heavy, resting on three points; these are for the purpose of carrying the tubes. The tubes are, however, perfectly free from

* See this Journal, Ser. 2, Vol. iii., 11. 18.

the troughs, except the first one, next to the eye-piece of the microscope, which is securely attached to one of the troughs. We will now describe the tubes; the first has a metal front, with a brass tube large enough for the body of the microscope to enter freely; this tube has a door in the left-hand side, also a very light vulcanite drop shutter, which can be released by a knob on the outside.

The intermediate tubes each contain nothing but a blackened diaphragm, for the purpose of cutting out internal reflections; there are four intermediate tubes, viz., two of one foot, one of two feet, and one of six inches. The joints are made so that they are interchangeable and light tight, even though they should not be placed very firmly together. These tubes are quite unimportant, and might be made of mill board. There is an end tube which contains a vulcanite flap shutter worked by a milled head on the outside; the back of this tube is grooved, so as to take the dark slide, ground glass, and repeating back. Close to the back is a fitting to hold metallic masks of various sizes. The ground glass is an important part which requires special attention. It is rather anomalous to call it a ground glass, as the final focussing is performed on clear glass; nevertheless a ground glass is indispensable for the purpose of arranging and roughly focussing the object upon.

The arrangement before you, which was designed in 1886, has been in constant use, and subsequent experience has suggested no improvement. The plane glass is held in a wooden frame, which is grooved so that it may slide in the back; on the plane glass, across the top and bottom, is ruled a scale of inches and mm.; the centre of the plate is denoted by faint diagonals; to the top of this frame is hinged the ground glass, and it is so arranged that it will remain up, when placed in that position. This is a more convenient plan than that of having two separate slides, one for the plane, and one for the ground glass. Further, the scales on the plane glass form an excellent micrometer for determining the magnifying power, as well as the size of objects; as these scales are ruled at the top and bottom of the glass, they in no wise interfere with the vision about the centre; the bottom scale can be brought to the centre, for micrometric and other purposes, by raising the frame, and the top one by its inversion. The back takes

only a $\frac{1}{4}$ plate, and the height of the centre of the plate above the board is the same as that of the optic axis of the microscope, viz., Powell's No. 1, when in a horizontal position.

The dark slide is one of Tylar's cheap metal double dark slides, used as a single dark slide; this is the smoothest working, and most suitable one for this purpose, that has yet been designed. One has merely to compare the draught of this metal slide, which costs 2s. 6d., with the most expensively made wooden one, to be convinced of its superiority.

Lightness is not only unnecessary, but is an absolute disadvantage in photomicrographic work, which in this respect differs from ordinary photographic work.

The microscope is so well known that it needs no description; it has been almost in constant use since it was purchased in 1876, the movements are still perfectly steady, and if anything smoother than at first. Quite recently diagonal rack work has been fitted to it, but the necessity for this alteration was not occasioned by any shake or loss of time in the old rack work, but diagonal rack work allows a smoother motion to be obtained with less pressure of the pinion in the rack. We next come to the method of gearing the fine adjustment to the fine adjustment rod. With this part of the apparatus several failures were experienced. A differential motion was first tried, next friction by rubber contact, thirdly the band, you now see, tightened by a spring, fourthly a similar band tightened by rubber, this was the first employed on this apparatus, lastly the same band tightened by a screw hook; which has never failed me. The conclusion formed with regard to this part of the apparatus is to avoid springs and rubber, however used. The rod being of smaller diameter than the head of the fine adjustment screw, the movement will be somewhat slower; of course, a perfect slow movement is a *sine quâ non* in high power photomicrographic work. The cord and weight as described by Mr. Bousfield is also a steady movement. The slow movement by the Campbell differential screw in Mr. Baker's microscope is very steady and peculiarly suitable for photomicrographic work; not only is this my own experience, but several eminent workers have told me that theirs was similar. The common direct acting screw will be found to be an inconveniently quick movement for photo-

micrography, especially if a $\frac{3}{4}$ cone of illumination is employed, with a wide angled oil immersion objective.

The connection of the focussing rod to the fine adjustment is necessarily more complex with a lateral screw than with an axial one, and on that account the axial movement may be considered preferable.

We now come to the illuminant, which is so important that several small details are unavoidable. There can be no doubt that oxy-hydrogen is a very, if not the most, suitable light for the purpose, for as to brightness there is enough and to spare, it is rich in actinic rays, it is thoroughly under control, it is inexpensive, it is perfectly safe; the last, but perhaps the most important, point is that it can be made small in size.

With regard to the brightness it should be remembered that six seconds and nine seconds can be more easily and more accurately timed than one second and one-and-a-half seconds, and with regard to the size it is not difficult to maintain a steady incandescent spot of lime quarter of an inch in diameter. For this purpose we have a common mixed jet with a small bored nozzle, fitted with the two usual taps and a common lime holder. The only thing peculiar about the jet is its flatness in front; this is to allow a short focussed lens to be placed close to it. The post to which the jet is attached is very massive, and the post is fastened to a heavy lead stand (weight 10 lbs.) resting on three points, having a large ventilating hole cut in it. This stand also forms the bottom of a small japanned tin lantern ($6 \times 4\frac{3}{4}$ and $6\frac{1}{4}$ high). The lantern has a door opening on the left hand side of the board, and the front, which has a removable tube fitting, can slide vertically. This lantern rests on a solid block of wood, which also rests on the board on three points. This block of wood holds also the heat interceptor, which is a plain water trough 2 inches thick with glass sides. You will observe that nothing throughout the apparatus is fixed; the only thing which occupies an approximately definite position is the microscope, which, of course, must be placed so that the fine adjustment cord can pass over the head of the fine adjustment screw; also its position in azimuth must be arranged so that the image will be projected in a line with the board. The microscope is so placed on the board that when you are looking down the tube the board is on your right hand.

Note, it is not necessary that the microscope and camera should be in the centre of the board, they can be placed close to the edge on the side you are working, a very slight bend over is then required to place the eye in the optic axis, as it is only $3\frac{1}{2}$ inches from the edge of the board; but the optic axis in the turn out microscopes, with 12×10 cameras fixed in the centre of the board, is probably three times that distance from the edge.

Below the board are two taps, one of which is fitted with a bye pass; this is of great use because when the jet taps have been once adjusted, the light can be turned on and off without disturbing them. The bye pass has also a tap, so that when it is in use the light can be made a mere pin's point; this, of course, saves gas. The advantage of having the bye pass separate from the lamp is obvious; you can turn the light up and down as many times as you please without the slightest risk of disturbing the centring or any of the adjustments.

With regard to the gas it is self-evident that if a pressure equal to that usually employed in an optical lantern is used, the size of the incandescent lime will be too large, and the light too brilliant for our work; the pressure, therefore, must be reduced.

It is, in some respects, not so easy to maintain a steady light with reduced pressures as it is with high pressures. A pressure equal to two inches of water is employed; this is obtained by using ordinary gas holders of five cubic feet capacity each. The oxygen one is charged from a cylinder, and the hydrogen from a gas bag, which has been filled from the main. The amount of gas consumed is small, probably not exceeding $1\frac{1}{2}$ cubic feet per hour; this, however, is by estimation, not by measurement.

The last and simplest, though important, part of a photomicrographer's outfit is a piece of white card; this should be in constant use, because by it the evenness of the illumination can at once be determined. This is its most important office, but it will be found useful in many other ways. For example, when working with a long camera composed of several tubes that awkward operation with ordinary apparatus, viz., the arrangement of the image at the far end, is simplicity itself, for it is only necessary to separate two tubes near the microscope end, when the state of the image at that point can be examined

by the insertion of the card. So difficult is this operation with a bellows camera that telescopes and opera glasses have been employed for the examination of the image at the far end, but the card and the moveable tubes render this quite unnecessary.

It is now necessary to explain the method of working this apparatus, and to point out the reasons for its special design, noticing especially where it most differs from the usual type of apparatus. The main points of difference are two in number: —1st, the absence of what is known as the turn out, and, 2ndly, the non-fixity of camera. With regard to these two points there are two photographic axioms to which your attention might be drawn. The first is that the photographic bench is not the proper place for microscopic observational work. In other words, the object about to be photographed should have been examined, the corrections of the objective, the size of the cone of illumination, and all the data necessary for the production of a critical image learnt before the object is brought to the photographic bench.

Further than this, if the critical image has been obtained by using a number eight diaphragm, it is necessary to hammer away at the photographic part until a successful negative has been obtained with that same diaphragm, for it is so easy to substitute a diaphragm two sizes smaller, and thus secure contrast. When once the object has been learnt, and the corrections, etc., are known, it is neither a difficult nor a long matter to reproduce the critical image on the photomicrographic bench. It is therefore quite unnecessary to turn out the microscope; and, secondly, the standing, and not the sitting, posture is the correct one for the photomicrographer to adopt. While on this subject it might be pointed out that vibration, a spectre which for long has haunted photomicrographers, mysèlf included, is in practice found to be a myth. If there is a microscope in the world more likely to be influenced by vibration than any other it is Powell's No. 1, for it has a long body and a long bar movement; nevertheless, during all the years it has been in use not a single negative has been lost through vibration, and, what is more, I never heard of anyone else losing one from that cause.

This being the case, how much less likely is a crane arm microscope to be affected by vibration? But so powerful has

been the influence of the spectre that it is deemed necessary to have heavy metal beds for these microscopes, for the purpose of strutting up the end of the crane arm; this, together with draw-tube and eye-piece clamps, is thought to be the correct design for a photomicrographic instrument. We now come to the funny part of the design in the class of apparatus referred to, for when all this hypercritical care is taken to make the instrument as rigid as a solid block of metal, the wooden base is cut and the whole put on a pivot. Even granting that a pivot is necessary, it is the camera with its base board that should be turned aside, the microscope being left unmoved on a firm trestle, which arrangement was invented some time back, and is still used.

The vibration scare is in a great measure due to the neglect of the re-examination of the image after the photograph has been taken; if that had been done it would be found that the loss of the negative was due to an alteration in focus, and not to vibration.

We will now take the second point, viz., the non-fixity of the camera. With some the camera evidently appears to be the end all, and the be all, of the apparatus, it is consequently fixed, and every adjustment, from the source of light to the eye-piece, has to be centred to its axis. But really the camera is the most unimportant part of the whole apparatus, for it can be entirely dispensed with; the late Dr. Woodward, for example, did not use one. The rule is, never mind where you project your image, but wherever it happens to come there place your plate. The things of primal importance are the obtaining of a visually critical image, and the correct projection of that image, but the exact position of that image has no importance. Mr. Bousfield has felt the intolerable nuisance of a fixed camera, so he has put traversing motions to the back of it to compensate for its fixation. Obviously, however, the non-fixity of the camera is the simplest way out of the difficulty, not to mention some other advantages it has. It must be mentioned that I have designed photomicrographic apparatus with fixed cameras, but then the end in view was cheapness (30/-), the moveability of the camera being sacrificed to that end. Bellows are, to my idea, not suitable for photomicrographic work, because a perfect apparatus must be capable of extension from six inches

to five or six feet; now long extension bellows are inconvenient to use, for you require one, if not two, intermediate frames to support the bellows, and these frames require continual attention during the extension or the closing of the bellows. Bellows, however, possess another disadvantage which is of greater importance, viz., that unless the bellows are considerably larger than the plate you will be troubled with internal reflections. The wooden tubes can, moreover, be extended and closed in a quarter of the time required for the bellows.

There is yet one other point in favour of this apparatus, viz., its range of power. The plate can be removed a distance of six feet from the eye-piece, its range, therefore, in that direction is ample; but it is also capable of performing very low power work, such as is quite impossible with some kinds of photomicrographic apparatus.

To effect this the back is alone used, the trough being reversed and the microscope connected to the camera by a cloth tube. On looking over my note-book, it appears that the lowest power there was occasion to employ was $3\frac{1}{4}$ diameters.

All the points in the construction of this apparatus have been gone over, and the differences which exist between it and other designs, as well as the reasons for those differences, have been explained.

Your time has been trespassed on too long, but you should know that this apparatus, which was made by Mr. Baker eight years ago, has worked without a single hitch, and I cannot conclude without expressing my obligation to Mr. C. L. Curties for the kind manner in which he superintended its construction, as well as for several valuable suggestions.

Gentlemen, I will detain you no longer, but thank you for your kind attention to this rather dry subject.

Note on Stauroneis legumen, Ehr., and some Allied Forms.

By G. C. Karop, F.R.M.S., etc.

Plate XVIII.

At the June meeting last year I announced that I had found *Stauroneis legumen*, Ehr., in a gathering from the River Lea given me a short time before by Mr. C. Haughton Gill, F.R.M.S. When the Journal appeared with this statement Mr. E. Grove asked me for specimens, which I had much pleasure in sending, and after examination he wrote to say that the diatom referred to was not *St. legumen*, Ehr., but *St. Smithii*, Grun., the *St. linearis* of W. Smith. I must, therefore, apologise for the mistake, which was founded on the authority of Brun., whose figure, Diat. des Alpes, Plate VIII., Fig. 26, is practically identical with the form from the Lea. In the text, p. 90, he gives *St. linearis*, W. Sm., *Pleurostauron lineare*, Hils., *St. Smithii*, Grun., and *Stauroptera legumen*, Rab., as synonyms. Rabenhorst likewise (Flora Eur. Algarum, p. 259) unites *Pleurostaurum legumen*, Ehr., with *Stauroneis linearis*, Sm., and considers *St. Smithii*, Bréb., as a 'forma curta' of the same. On turning to Kützing's 'Bacillarien,' I found figures of *St. legumen*, Plate XXIX., Fig. 11, and *St. linearis*, Plate XXX., Fig. 26, which, with their respective descriptions, are evidently copied from Ehrenberg's Verbreit. u. einfluss d. mikros. lebens in S. u. N. Amerika, Berlin, 1841, with later additions 1843. The figure of *St. legumen* in Van Heurck's Syn. d. Diat. de Belg., Plate IV., Fig. 11, to which Mr. Grove referred me, is totally unlike Ehrenberg's original figure, which is broad and inflated, while Van Heurck's is narrower and more linear. Mr. Grove tells me he has never actually seen *St. legumen*, from which we may infer that it is an exceedingly rare form. Recently it was reported from one of the Italian Alpine Lakes by Signor P. Pero in La Nuova Notarisia, and I wrote to Prof. De Toni to know if specimens could be obtained. He very

kindly undertook to ask Signor Pero, but, at any rate as yet, I have not received any. I also wrote to Dr. A. M. Edwards, of Newark, New Jersey, U.S.A. It would be very interesting to compare specimens named by competent observers from different localities to see how far they correspond. In a paper in the Proceedings Acad. Nat. Sci. of Philadelphia, published in 1865, by Dr. F. W. Lewis, entitled "On some extreme and exceptional variations of Diatoms from some White Mountain localities," I find a figure (Plate II., Fig. 14) of *St. legumen*, so-called, styled "the aberrant variety," which differs greatly from the type form, being without apiculated extremities and possessing no inflations, and Mr. Grove informs me that it is not *St. legumen* at all, but, according to Cleve, the *St. obtusa* of Lagerstedt, described in his Diatoms from Spitzbergen. Gregory also gives a figure of *St. legumen* in the plate accompanying his paper on "New Species of Brit. F. W. Diatomaceæ" in the Quart. Jour. Micros. Sci. for 1856 (Plate I., Fig. 9), but there is no comment in the text.

In order that these various figures may be compared without the trouble of consulting the several authors cited, I have copied them as faithfully as possible on Plate XVIII., including an original figure of the Lea form, and I trust we may have some further communications on this interesting subject.

It should be stated that *St. legumen*, *St. linearis*, with some half-dozen other allied forms, including *St. acuta*, now constitute the division 'Pleurostaurum' of Rabenhorst, which Grunow and Cleve have adopted, altering the final syllable *um* to *on*, thus 'Pleurostauron.'

While these remarks were in the printer's hands I received some slides (and material) from Dr. Edwards, labelled 'Raised Coast Period, Peddie Street Ditch, Newark, N.J.,' which he said contained a few specimens of the form figured by Lewis, and which, in his opinion, in spite of the difference in outline from the Chili or type form of Ehrenberg, were to be referred to *S. legumen*.

Unfortunately the slides were mostly broken in transmission, but by careful examination I have found one or two of the diatoms in question, which appear to me to be intermediate between Lewis's 'aberrant variety' and *S. linearis*, possessing the entire outline of the former with the apiculated extremities

of the latter. There has been no time to clean the material from Newark or to make a drawing of the specimens on Dr. Edwards' slides.

Explanation of Figures, Plate XVIII.

Fig. 1. *Pleurostauron* (*Stauroneis*) (*Stauroptera*) *legumen*, Ehr. After Ehrenberg, *loc. cit.*, and Kützing, Die Bacillarien.

,, 2. *Pleurostauron* (*Stauroneis*) *linearis*, Ehr. (= *St. Smithii*, Grun.). After Ehrenberg, *loc. cit.*, and Kützing, Die Bacillarien.

,, 3. *Pleurostauron* (*Stauroneis*) *legumen*. After Van Heurck. Diat. d. Belgique.

,, 4. *Pleurostauron* (*Stauroneis*) *legumen*, "aberrant variety." After F. W. Lewis, *loc. cit.* = *St. obtusa*, Lagers.

,, 5. *Pleurostauron* (*Stauroneis*) *linearis*. River Lea, drawn with 4 mm. Apo. Zeiss; Comp. Ocular 12.

,, 6. *Pleurostauron* (*Stauroneis*) *legumen*. After Brun. Diat. d. Alpes, Plate VIII., Fig. 26.

,, 7. *Pleurostauron* (*Stauroneis*) *legumen*. After W. Gregory. Quart. Jour. Mic. Sci., Vol. IV., Plate I., Fig. 9, 1856.

Note on Some Minute Forms of Pond Life.

By Edward M. Nelson, F.R.M.S.

(Read January 19th, 1894.)

In pond-life observations, conducted under low and medium powers, especially when a dark ground is used, minute organisms may often be seen sparkling like dust. The examination of these dust-like bodies under a high power has revealed, among a host of ordinary and common bacilli, not a few strange forms, an account of which will perhaps be of interest.

First let me state that in this kind of observation, when using an oil immersion $\frac{1}{12}$ and powers of 1,500 diameters, I found Rousselet's compressor invaluable; with it work was performed as easily as on an ordinary balsam-mounted diatom.

I will first describe three filamentous bodies, which, though somewhat of the same shape, were evidently quite distinct, and functionally different from one another.

1. An organism having a thread-shaped body, varying in length from, say, a half-thousandth to one-thousandth of an inch; excessively thin, say $\frac{1}{70000}$ to $\frac{1}{80000}$ inch; no structure visible; movement, a stiffish bending. A bacterium in a leptothrix stage (?)

2. Was also a rod-shaped body, longer and a little thicker than the former. Numerous granules could be detected inside when the aperture of the condenser was fully opened and the resolving power of the objective pushed to its utmost capabilities. The movement was backwards and forwards like a Melosira. A diatom (?).

3. Was a similar shaped organism, about one-thousandth of an inch long, having an elliptical swelling in the middle. This elliptical portion was about $\frac{1}{12}$ of the whole length of the organism. No structure could be detected. Its movement was not at all amœboid, but more like that of a worm. The largest of these three organisms was not so thick as a common spirillum.

Leaving now unknown ground, we come to an organism which can be recognized as a *Spirochæta plicatilis*.

It was not a large specimen, being in length about a thousandth of an inch, and as thick as a tubercle bacillus.

The movement of this organism was so peculiar and interesting that it is worth describing at some length.

If a spiral is wound round a journal revolving in bearings its motion will not appear as a rotation, but as a progression in a line with the axis of the journal. This optical illusion is sometimes employed for the purpose of imitating a cascade of water by means of rotating glass spirals. But if the journal be advanced during every revolution a distance equal to the pitch of the screw, then the spiral will appear to be perfectly stationary.

The form of the ordinary Spirochæta is well known; among the various wriggling and other movements of this organism one is especially important. Suppose we adjust and focus an oil $\frac{1}{12}$ giving 1,500 diameters on one particular convolution in the middle of the organism, we shall see that while this particular convolution is apparently stationary the end on one side is being rapidly drawn in towards the middle, while the other end is as rapidly extended. This movement is then repeated in a contrary direction, and often several times backwards and forwards in succession. At first I was completely deceived by this complicated movement, and was eagerly seeking for some swelling or thickening of the body, which would permit of a contraction at one end and a corresponding thinning of the other side to allow of an extension.

After being engaged in this fruitless search for some considerable time I at length perceived the true explanation, viz., that the spiral rotated at a high velocity, the organism advancing a distance equal to the pitch of the screw during each revolution.

It is interesting to note the marked difference between the appearance of this organism and a Spirillum. A spirillum does not advance nearly so much as the length of the pitch of the screw during each revolution, consequently it appears when in movement like a hollow ellipsoid made of spirally interlacing bands of basket-work, an effect wholly different to that produced by a moving Spirochæta.

Note on Fungi Parasitic on Diatoms.

By J. G. Grenfell, B.A., F.R.M.S.

(Taken as read February 19th, 1894.)

In the Botanical Gardens in the Regent's Park there are now to be found specimens of Chytridiaceous fungi parasitic on diatoms. They occur on *Stauroneis phœnicenteron*, and on a very small Navicula, probably *N. sphærophora*.

The parasite of Stauroneis is an apparently new species of the genus Rhizophidium. The branching mycelium embracing the chromatophores of the diatom is very well seen. The external zoosporangium is pear-shaped. The parasite of the Navicula is probably distinct. No mycelium has yet been seen. The general appearance of both is very similar to the *Septocarpus* figured in the Quekett Club Journal for July, 1889, Plate II., appended to Mr. Karop's translation of a paper by Zopf. In Septocarpus, however, the lower portion of the sporangium is shut off by a septum, and contains no swarm-spores. There is no trace of this here. Several chytridiaceous fungi have been found on diatoms in Germany, but none have been recorded in England.

Note on Mr. Henry Keevil's Section of Flint.

PLATE XVIII.

Mr. Henry Keevil, of Bath, has kindly sent for examination a section of flint, which contains several interesting objects. Mr. Keevil found the stone, which measures $1\frac{3}{4}$ by $1\frac{1}{8}$, in some road metal; he broke it with a hammer, and its fracture shows a considerable thickness of white material round a pale brown core; one of the brown splinters, which he ground down and polished, forms the section in question. A microscopical examination of the slide reveals, first, a number of small spherical bodies, fairly uniform in size, with a diameter of ·0016 inch. There are two separate patches crowded with these bodies in the section.

Two of these spherical bodies, as seen under an apochromatic $\frac{1}{8}$ of 1·4 N.A. with polarized light, are represented in Plate XVIII.

The next figure is that of a flask-shaped body full of similar spherical bodies. Its size is as follows: Major axis ·0217 inch, minor axis ·016 inch.

The third figure is that of a sector-shaped body, the length from its apex to the centre of the arc being ·0068 inch; it is apparently divided into segments.

The slide also contains some small fragments of sponge structure, but its chief interest centres in those objects which Mr. Karop has kindly figured in Plate XVIII.

It was thought desirable to submit the slide to those who had made this subject a special study. We are informed, first, that the small spherical bodies are not organic, but are a part of a process of crystallization, similar bodies being found in "chert;" secondly, that the flask-shaped body is a pseudomorph of a foraminifer of the species *Lagena*, and, thirdly, that the sector-shaped body is an oblique section of another species of foraminifer *Cristellaria*. We are indebted to Prof. T. Rupert Jones, F.R.S., for so kindly naming these Foraminifera.

PROCEEDINGS.

October 20th, 1893.—Ordinary Meeting.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. John W. Barnes, Rev. G. H. Preston, M.A., Mr. W. B. Boyes.

The following donations to the Club were announced:—

"Journal of the Royal Microscopical Society"	From the Society.
"Proceedings of the Royal Society" ...	"
"Science Gossip"	From the Editor.
"American Monthly Microscopical Journal"	In Exchange.
"The Microscope"	"
"The Botanical Gazette"	"
"Le Diatomiste"...	"
"Proceedings of the New York Microscopical Society"	"
"Quarterly Journal of Microscopical Science"	Purchased.
"Proceedings of the Manchester Literary and Philosophical Society"	In Exchange.
"Report and Transactions of the Manchester Microscopical Society"	"
"International Journal of Microscopy"	"
"Proceedings of the Academy of Natural Sciences, Philadelphia"	"
"Proceedings of the Geologists' Association"	"
"Proceedings of the Hertfordshire Natural History Society" ...	"

"Annals and Magazine of Natural History"	Purchased.
"Larvæ of British Butterflies and Moths"...	Ray Society.
"On the Measurement of Light and Colour Sensation"	Mr. Lovibond.

The thanks of the Club were voted to the donors.

The Secretary said they had also received a prospectus of a work on the Diatomaceæ, to be brought out by Dr. Arthur Meade Edwards by subscription, at three dollars per copy. Also a more extensive work, to be edited by M. Peregallo, entitled "Catalogue Général des Diatomées." This was intended to be somewhat upon the lines of the catalogue brought out some years ago by Habirshaw, but it would be more exhaustive and up to date. It was proposed to complete it in twenty-five numbers, at a cost not to exceed 50fr. There must, he thought, be many persons to whom such a work was likely to be of great value. He also exhibited and described the chief points of two new microscopes brought out recently by Mr. Swift. In the main these instruments resembled Mr. Swift's small model. The cheaper of the two was mounted upon a light tripod stand, which was extremely firm, and when placed in a horizontal position the limb rested upon the leg in a way which secured great steadiness. The substage fitting and other parts were made to gauge; the fine adjustment was always apt to wear loose after a time, but by means of a little clamping screw it could in this case always be kept tight against the anterior bearing; the price with box and two objectives was only £5 15s. The other microscope was somewhat similar, but rather heavier, and was altogether as nice a moderate priced instrument as could be desired for only £8.

The President said he had examined these instruments, and thought they were very beautiful specimens of workmanship, and he was glad to find good and cheap microscopes without the horseshoe foot; they were fitted also with iris diaphragms, and microscopes of this kind were capable of doing first rate work. The only thing he objected to was the arrangement of the stage, which had two grooves ploughed into the top. He was also opposed to spring clips, which prevented anyone from feeling the distance; this had caused more breakage to

objective fronts than anything else. The President said they had also another microscope, made by Herr Leitz, and sent for exhibition by Mr. Curties; a foreign microscope without the horseshoe foot! Truly a marvellous change. They had been continuously told for so many years that the Continental model was the only correct one; the German instrument before them embodied almost every English feature. With regard to the Oberhaeuser model it had been all along in a state of continual shift, until now in this the latest development of it, they had a tripod stand, an inclining body, a rack-work coarse adjustment, draw tube, an extremely ingenious fine adjustment, a rotating nose piece, all of which were borrowed from English models. In this instrument there was an Abbe condenser, with a mirror fastened to the condenser. This plan of fixing the mirror might be unobjectionable for daylight illumination, but with artificial light the image of the source of the illumination would be moved by every alteration in the focus of the condenser. There was also a turn-out arm with Abbe's rack-work traversing diaphragm holder, which was of no use and much in the way. The microscope was also fitted with a 13-leaved diaphragm, very beautifully made, and a centring substage, which was, however, applied to the condenser but not to the diaphragm. But one of the most novel fittings in this microscope was the way in which the groove for the substage was contrived. It was not a V, and the rack was not placed inside it, and the problem at first sight was—how did they get a smooth and proper fitting without grooves? On examination it was found to be done by means of a piece of steel with a spring which was tightened up by screws at the back. He did not know what was the price of this instrument complete, but he was told it was the same as the old one.

Mr. T. F. Smith thought that it would be a great improvement if the iris diaphragm could be fitted so as to show on a scale exactly what aperture was in use at any given position of the lever.

The President said Mr. Smith was quite right as to the desirability of some means of ascertaining the aperture in use at any position of the lever, but it seemed at present a difficult matter to accomplish because a very small movement of the lever made a great difference in the size.

Mr. Western read a description by Mr. Dixon-Nuttall, of a male Rotifer, *Copeus pachyurus*, the genus *Copeus* being one taken from *Notommata* by Goss, and consisting of a few species of soft bodied free swimming Rotifers.

Mr. T. F. Smith exhibited upon the screen a series of photographs illustrative of the structure of *Pleurosigma angulatum*, etc.

The President said they had been treated to a very beautiful exhibition of photographs by Mr. Smith; there were clearly no "ghost" images there, and those who could not believe in them would not be likely to believe in anything.

The thanks of the meeting were voted to Mr. Dixon-Nuttall, Mr. Western, and Mr. T. F. Smith.

The Secretary said that the material belonging to the late Mr. Hailes was in the hands of Mr. Priest; applications for the same were to be made to the Committee.

The following objects were exhibited:—

Brachionus urceolaris	Mr. W. Burton.
Leitz microscope	Mr. C. L. Curties.
Ambulacral foot of *Echinus* ...	Mr. J. D. Hardy.
Eudendrium ramosum	Mr. J. D. Hardy.
Eudendrium ramosum (Gonophores) ...	Mr. G. E. Mainland.
Cristatella mucedo	Mr. F. St. John Parker.
Melicerta Janus (mounted, fully extended)	Mr. C. Rousselet.
Two Student's microscopes	Messrs. Swift & Son.

NOVEMBER 3RD, 1893.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Notops hyptopus	Mr. W. Burton.
Eurydice pulchra	Mr. G. E. Mainland.
Terpsinoë intermedia, sporangial forms	Mr. H. Morland.
Stephanoceros Eichornii (mounted, fully extended)	Mr. C. Rousselet.

NOVEMBER 17TH, 1893.—ORDINARY MEETING.

A. D. MICHAEL, Esq., P.R.M.S., F.L.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Messrs. E. E. Hill and G. J. Randell were balloted for and duly elected members of the Club.

The following donations to the Club were announced:—

"Annals of Natural History" ...	Purchased.
"Proceedings of the Brighton and Sussex Natural History Society"	From the Society.
"La Nuova Notarisia"	In Exchange.
"Memoir on the Gastrotrichia," by Carl Zelinka	From Mr. Rousselet.
"Proceedings of the Belgian Microscopical Society"	From the Society.

The thanks of the Club were voted to the donors, amongst whom Mr. Rousselet was specially named.

The Secretary announced that the President was unavoidably absent from the meeting, being unfortunately laid up with influenza. He also referred to the recent death of Dr. Kützing, the distinguished algologist, of whom he read a short memoir, of which the following is a summary:—

"I am sure many members will hear with regret the death of the veteran algologist, Dr. Friedrich Traugott Kützing, which is recorded in the current number of 'La Nuova Notarisia,' although the date is not given.* There can hardly be a microscopist to whom the name, at least, is not familiar, and although, so far as I know, it is many years since he wrote anything, his works on Algæ, and particularly the Diatomaceæ, if in some respects necessarily superseded by advancing knowledge, are still indispensable to the systematic student, and will bear enduring testimony to his patient and devoted labours, at a time when the pursuit of this branch of science was new and difficult, and offered hardly any other reward than the esteem of his fellow-workers in the same field. His earliest paper known to me was on the genera Melosira and Fragilaria in 'Linnæa' in

* F. T. Kützing, born December, 1807, died at Nordhausen, September 9th, 1893. See "Hedwigia," Heft 3, 1893, p. 329-333.

1833, or just 60 years ago, followed by 'Synopsis Diatomearum,' in the same year, or the year after. It was now (1834) that he made the discovery of the silicious nature of the diatom frustule, and that the cell-contents contained iron; but although this was confirmed he could not get his paper printed in the Proceedings of the Berlin Academy of Sciences, and later on Ehrenberg quietly appropriated the latter part as his own. Perhaps his best known work, 'Die Kieselschaligen Bacillarien,' appeared in 1844, reprinted with additions in 1865. The plates, drawn by himself, are many of them excellent; in others, the figures are very minute and crowded; but the instrumental means at his disposal were very deficient, as he owns, and from the conditions of microscope manufacture in his early days could, perhaps, hardly be helped. It would be interesting at the present to see the instrument with which he first worked. In 1845 was published his 'Phycologia Germanica,' or concise descriptions of German algæ, and in 1846 he began the issue of a large illustrated work on marine algæ, entitled 'Tabulæ Phycologicæ,' which extended over some twenty or more years. This was followed by 'Species Algarum,' in 1849, and the art. 'Diatomaceæ' in Grundzüge der Philosophischen Botanik, 1851-2. No doubt an extended biography of Kützing, whom Dr. De Toni styles the 'Nestor of Algology,' will appear in some scientific paper; but I could not refrain from some notice, however meagre, of such a man and microscopist who has now paid the debt of nature after a long and useful life."

The Chairman was sure that the members would hear with great regret of the death of Dr. Kützing, and that they would all join in the vote of thanks to Mr. Karop for the careful way in which he had worked up the interesting account he had given them.

Mr. R. T. Lewis said that he had exhibited under a microscope at the end of the room a specimen of the hair of some animal, which he was anxious if possible to identify. Perhaps in explanation he might say that a few months ago he received from a correspondent in Natal a curious object, apparently formed of white cottony hairs felted together, which was sent under the impression that it might be an owl's cast. Upon examination, however, it was found to have been woven to-

gether upon a twig; the interior was divided into three compartments, each of which contained a small quantity of what looked like greengage jam. On placing a sample of this under the microscope it was seen to consist almost entirely of pollen, mixed into a mass with some colloid substance easily soluble in water. The material of which the structure was composed was also seen under the microscope to consist of vegetable hairs, scarcely distinguishable from those found in the stem and leaves of the Edelweiss. There could be no doubt that the object was the nest of some kind of bee, and that the pollen had been collected as food for the larvæ. On searching at the Natural History Museum he found specimens of similar nests, which were said to be those of *Serapis denticulatus*, and the hair was said to come from a species of Cape Everlasting (Helipterium). Some time later he received another structure apparently of a similar kind, but though the inner portion was made of vegetable hairs felted together, as in the former case, the outside was covered with a dense layer of dark hair, obviously that of some small fur-bearing animal. This nest had suffered a good deal at the hands of some local investigator, but he found that the plan of its construction was much the same as the other, and that the "jam" inside was of a bright vermilion colour. This colour was discharged at once by the action of benzole. and the pollen of which the mass was composed was indistinguishable from that in the nest before mentioned. He was unable at the time to identify this with anything previously described, and there seemed little chance of ascertaining what kind of bee had constructed it. This question, however, unexpectedly settled itself during his absence from home in September; for on returning he found a bee in the box with the nest, which had obviously emerged from the pupa state in the interim. This was identified at the Museum with those of the genus *Serapis*, whilst the tooth-like spines along the sides of the abdomen suggested that the specific name *denticulatus* would aptly apply. A third nest had since then been received; this was built upon an apple twig, and differed somewhat in shape and construction from the others. He had not yet examined the internal arrangements, in the hope that if undisturbed in this case also some of the insects might develop. As regarded the animal's hair, it seemed to agree in

character with that of the rat tribe, and if any member could, on inspection, say what it was the finder would be glad of the information. The three nests referred to were handed round for inspection.

Mr. Michael said he was not at all a specialist on the subject of bees, but he had some experience in the matter of the nests made by humble-bees, and it appeared to him that they did not confine themselves invariably to one kind or particular class of fibre or hair, so that it was frequently possible to find in the nest of the same bee layers of different kinds of hairs; they did not seem to be particular as to the material they used, but probably took what was nearest to hand.

Mr. Rousselet read a paper by Mr. Hood, "On *Floscularia cucullata*," sp. nov., Hood.

Mr. Western said he had an opportunity of seeing this Floscule, and regarded it as a very interesting addition to the number already described.

Mr. Rousselet drew the attention of the members to a specimen of the male of *Stephanoceros*, which, he believed, was exhibited in the room that evening for the first time.

Mr. T. B. Rosseter's paper on *Cysticercus quadricurvatus* was read by Mr. Vezey.

Mr. Karop said it was hardly possible to expect much discussion on a paper of that kind, because, unfortunately, no one but Mr. Rosseter seemed to have worked at it, although there were undoubtedly a large number of these forms which it certainly was desirable to know something about. The cysticercus would be swallowed with the entomostraca, and would ultimately reach its final host, in the interior of which it would become changed into a tape-worm as usual, but that remained to be discovered, as in so many other cases.

The Chairman said they were very much obliged to Mr. Rosseter for his very careful observations upon the subject, which was one well worthy of the attention of microscopists, especially in regard to the important part which these organisms might play in their ultimate state.

The thanks of the Club were unanimously given to the authors of the papers read, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Spongilla fluviatilis	Mr. W. Burton.
Catkin of Yew with pollen	Mr. H. E. Freeman.
Stephanoceros Eichornii, ♂ ♀, mounted, fully extended	Mr. C. F. Rousselet.
Haliclystus octoradiatus, mounted ...	Mr. Chas. D. Soar.

December 1st, 1893.—Conversational Meeting.

The following objects were exhibited:—

Distemma, sp.	Mr. W. Burton.
Diatoms from Port Royal, Jamaica ...	Mr. J. G. Grenfell.
Aulacodiscus Schmidtii, front and side views	Mr. H. Morland.
Foraminifera	Mr. B. W. Priest.

December 15th, 1893.—Ordinary Meeting.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Sir George Lampson, Bart., Mr. Gerald Sturt, and Mr. J. T. Holder.

The President said that many members would hear with regret of the death of Mr. S. J. McIntire, one of the oldest members of the Club, and known, not only to them, but to the microscopical world at large, by his many contributions to their knowledge which had been published from time to time in their Journal as well as in other publications.

The following donations to the Library were announced:—

"The Essex Naturalist"	In Exchange.
"The Botanical Gazette"	"
"Proceedings of the Scottish Microscopical Society"	From the Society.
"Le Diatomiste"	
"Annals of Natural History"	Purchased.

Prof. B. T. Lowne gave an interesting account of the Metamorphoses of Insects, illustrating the subject by diagrams drawn upon the board.

The thanks of the meeting were, upon the motion of the President, unanimously voted to Prof. Lowne for his extremely interesting lecture.

Mr. T. F. Smith read a paper on "Diatom Structure," photomicrographs in illustration of the subject being exhibited upon the screen by the President.

A vote of thanks was passed to Mr. Smith for his communication.

The following objects were exhibited:—

Notommata Naïas	Mr. W. Burton.
Section of terminal leaf bud of Hawthorn, *Cratagus oxycanthus*, showing growth of leaves, bark, resin cells, and raphides in pith	Mr. H. E. Freeman.
Notommata tuba, Ehr., mounted ..	Mr. C. F. Rousselet.

January 5th, 1894.—Conversational Meeting.

The following objects were exhibited:—

Campylodiscus Wallichianus	Mr. H. Morland.
Pond life in Midwinter ... ... *Melicerta ringens* ... ... *Oecistes crystallinus* ... *Floscularia cornuta*... ... *Limnias ceratophylli* ... Vorticellæ and other Infusoria in great abundance on same twig	Mr. C. F. Rousselet.

Ordinary Meeting.—January 19th, 1894.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Dr. J. M. Barbour and Mr. C. P. Roberts were balloted for and duly elected Members of the Club.

The following donations were announced:—

Braithwaite's "British Moss Flora," Part XV.	From the Author.
"Proceedings of the Scientific Society of Chili"	From the Society.

"Transactions of the Scientific Society of Wisconsin"	From the Society.
T. C. White, "The Microscope and How to Use It," 2nd edition	From the Author.

The thanks of the Society were voted to the donors.

Mr. T. C. White said the book which he had the pleasure of presenting to the Society was a very unpretentious little work, which probably would not communicate anything to members of the Q. M. C. which they did not know already. His aim had been to provide beginners with some simple directions to enable them to select objects and to examine them in a manner which would be most likely to afford them the greatest amount of instruction and interest. They would find a chapter on Microscopical Societies, in which he had strongly recommended beginners to join the Q. M. C., and it would also be seen that he had dedicated the volume to the Club which he loved so well. There was also a chapter on photomicrography, but the prints of the photographs with which the book was illustrated were hardly so good as they might have been.

The President was sure the members of the Club would feel very much obliged to Mr. White, not only for presenting this book, but also for dedicating it to the Club, and he could only hope that his suggestion that beginners should join the Club would be largely acted upon, because it would undoubtedly mean the saving of a great deal of valuable time to those who were desirous of obtaining hints and information from those more experienced than themselves. He had not yet read the book, but he had just looked at the photographs. He liked them especially because they were the original prints stuck in, and not photo-mechanical reproductions, in which the finer details were often to a large extent destroyed. He moved that they should give a hearty vote of thanks to Mr. White for his gift, and for his kindly notice of the Club in it.

The thanks of the Club were voted to Mr. White accordingly.

The Secretary said that their next meeting would be the annual meeting of the Club, at which the election of officers for the ensuing year would take place. There would also be five vacancies to fill up on the Committee, and nominations for these must be made at the present meeting.

Nominations made by the Committee for President and

Officers were then read, and the following members were nominated to fill vacancies on the Committee :—Messrs. Ingpen, Reed, Spencer, Mainland, and Priest.

Mr. J. D. Hardy was also nominated and duly elected Auditor on behalf of the members.

Mr. Grenfell said he had brought for exhibition an exceptionally large specimen of *Rhizosolenia robusta* (?), the largest British diatom he had seen. It came from Plymouth. Its length when complete was $\frac{1}{30}$ inch at least, its breadth $\frac{1}{150}$ inch. These dimensions are about $1\frac{1}{2}$ times those given in Pritchard's figure, Pl. 8, from Norman's MS. The fine markings are rows of dots which he was unable to count; Robusta has about 55,000 to the inch. The specimen was stained with methylen blue, which some diatomists might object to, but he did not think it interfered in any way with the markings. He had been working at a very interesting gathering from Plymouth which contained several species of diatoms with the pseudopodia-like filaments he had found in fresh water forms. One of these species could not be found on slides of burnt or acidised material ; it was apparently destroyed by these violent measures. He therefore simply washed the material and dried it on the cover glass. If this is put into styrax the more delicate forms such as the one in question, *asterionella*, and others vanish entirely or are so transparent as to be practically useless, and are very trying to the eye to find. All traces of the pseudopodia-like filaments vanish if any were present. The addition of alcohol and a little methylen blue allowed to dry on the slide remedies these defects to a certain extent. The stained delicate forms are very much easier to see, which is a great relief to the eye, and in some cases the filaments may be stained also, as in the case of a Coscinodiscus on the same slide. But the method is not specially adapted to these filaments. Styrax utterly destroys all markings on another new form in this gathering allied to *Thalassiosira*, whether stained or not. In every gathering of diatoms some slides should be prepared in this, or some similar way, if delicate forms are at all likely to be present.

Mr. Karop did not see that they were left to the alternatives of bleaching or burning. Why not treat the protoplasm with some fixing medium before mounting ? He feared it would be

difficult to persuade a biologist that it did not matter how the material was treated.

Mr. Ingpen thought it would hardly be possible to count the striæ without some previous preparation, although it might, perhaps, be done by mounting in some of the higher refractive media, such as sulphide of arsenic. He had found that in the case of some of the smaller specimens of *Rhomboides* when they had been kept for a long time, so as to let the protoplasmic matter decay, and were then mounted in one of these media, the result was fairly satisfactory. Mr. Meates used with success bromide of antimony and bromide of arsenic, the index of which was much higher than that of styrax. He had found this to be good. It was very fugitive, but did not require much heat. It was then much easier to count the lines, there being as much difference as between lines made with a faint pencil and with ink.

Mr. Mainland said that he had mounted some diatoms about nine years ago in Barff's boro-glyceride, and these had kept perfectly good to the present time. He used a saturated solution, and ringed the covers with Miller's cement.

The President thought this would be a valuable addition to their mounting media. It would also be of great use if they could work successfully with quinidine, which gave them the best results yet obtained. It was beautifully white, and the refractive index was very high. The first slide he possessed had no cement round it of any sort, and it was still perfect. A friend showed him how to mount with quinidine, and it seemed a very simple process, but when he tried it it generally crystallized in about five minutes. As to counting striæ, he thought he could give them a wrinkle. It was a method much the same as one employed to discover the number of lines to an inch in test objects by Sir D. Brewster, who said that "he saw distinctly the fringes of colour produced by interference, and on measuring the angular distances of the first red fringe from the light he found that the distance of the lines, or rather the diameter of one black line and half the bright space between the lines, varied from the 10,000th to the 22,000th of an inch." The application of this method of Sir D. Brewster's was very simple. If, for example, a diatom placed under an objective of ·5 N.A., and illuminated by a narrow oblique pencil, gave an

effect at the back of the objective, such that the dioptric beam was at the extreme edge of the lens and the first diffraction spectrum at the opposite edge of it, then a glance at the aperture table in the "R. M. S. Journal" would show you that the striation was a little less than 48,000 per inch. But if, when a narrow angled central beam were used, both the 1st order spectra were at the opposite edges of the lens, then the striation would be somewhat less than 24,000 per inch, viz., half the amount given in the table. If only, therefore, the N.A. of the objective is known a rough estimation of the fineness of the striation may be arrived at by inspection, without the necessity of employing micrometers. The error of the estimation will be within the variation of the fineness of the striation of the diatomaceæ. Of course it is better to select such an objective as will show the spectra at the edge of its aperture with central light, or the dioptric beam and a spectrum with oblique light. Mr. Ingpen's medium was an exceedingly valuable one, but he was very much afraid that it was only good for temporary purposes. All his own slides had gone bad except one mounted by Prof. Hamilton Smith and one mounted by Father Thompson. Of those sent over by Prof. Hamilton Smith only four or five out of a box full remained uncrystallized. Of these one was still intact, but the rest showed signs of crystallization. It was a great pity that so useful a medium should be so uncertain, but he feared that all these arsenical preparations were wanting in permanence.

Mr. Ingpen said that compounds of sulphur and arsenic alone were more permanent than those containing bromide. He could quite endorse the President's remarks as to quinidine, to which his attention was called on finding that piperine was so irrational that it was of little use for photography. One of the elements of success or failure was to be found in what the diatoms had been kept in previous to mounting. A lot mounted by Mr. Suffolk, which had never been put into anything but weak alcohol, stood very well, whilst some more which had been cleaned and acidulated would not stand. Of his specimens in quinidine mounted years ago some were still good, and others completely gone. A second or third melting seemed essential to success; a single melting was not sufficient to preserve them.

Mr. Karop said he had some experience with quinidine. The

usual salt was a synthetic body, and to mount with it successfully they must find its absolute melting point, and must drive off the whole of the water of crystallization. If there was any moisture in the air when the mounting was done it would recombine and crystallize again, but if done in a dry oven it would generally succeed. If, however, there was the faintest trace of water crystals would be sure to form in it.

The President then read a note "On Some Minute Forms of Pond Life."

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Rhizosolenia robusta, large size, $\frac{1}{30}$ inch	Mr. J. G. Grenfell.
Euchlanis lyra, mounted	Mr. C. F. Rousselet.

February 2nd, 1894.—Conversational Meeting.

The following objects were exhibited:—

Thalassiosira Nordenskioldii, exhibiting a membrane connecting the frustules which is destroyed by acid or burning	Mr. J. G. Grenfell.
Aphides in an apple core	Mr. G. E. Mainland.
Stylobiblium Japonicum, from Japanese lignite	Mr. H. Morland.
Siliceous and Calcareous Sponges ...	Mr. B. W. Priest.
Lophopus crystallinus (mounted) ...	Mr. C. F. Rousselet.

February 16th, 1894.—Annual Meeting.

E. M. Nelson, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. Edward Praill and Mr. Harry Wade were balloted for, and duly elected members of the Club.

The following donations were announced:—

"Proceedings of the Belgian Microscopical Society"	From the Society.
"Annals of Natural History	Purchased.

The President having nominated Mr. J. M. Allen and Mr. J. D. Hardy to act as Scrutineers, the ballot for Officers and Council for the ensuing year was proceeded with, it being subsequently declared that the whole of the gentlemen on the printed list had been unanimously elected.

The Twenty-eighth Annual Report was then read by the Secretary.

The Treasurer read his statement of account and balance sheet for the year 1893, which had been duly audited and certified as correct by Messrs. Hardy and Chapman.

It was moved by Mr. J. Slade, seconded, and unanimously resolved that the report and statement of account now read be received and adopted, and that they be printed and circulated in the usual way.

The President having expressed his thanks to the members for the renewed expression of their confidence in having re-elected him to the office of President of the Society, proceeded to deliver the customary Presidential Address, the first portion of which dealt with the recent improvements in the microscope and its accessories, and concluded with a description of his own improved apparatus for photo-micrography, which was exhibited in the room in its complete form, as ready for use.

Mr. A. D. Michael had very great pleasure in moving a hearty vote of thanks to the President for his admirable address. It would be felt by all who had listened to it that the summary with which it commenced would form a storehouse of information for future reference, which could not fail to be of great service; whilst the account he had given of his own progress in the art of photo-micrography had been extremely interesting, and could hardly fail to be equally useful. The exhibition of the apparatus had also added greatly to the interest of the subject, as showing by what means those results had been produced, which the President of the Club might well be proud of, and which certainly would not be easily beaten.

Mr. J. E. Ingpen said he had great pleasure in seconding the vote ᶜ thanks. He had known Mr. Nelson for a long time, and had a high opinion of his work. He had always made a point of directing their attention to important improvements in the microscope (not a few of which had been due to his own invention and suggestion), and also of criticising points of theory

upon which opinions often differed. Those who knew him best knew how much they were indebted to him in these respects. He might refer to two or three suggestions mentioned in the address. Mr. Burch's micrometer was introduced at the Club some years ago, but had never come into general use, although it was a most efficient instrument for many purposes beside microscopy. Mr. Michael's polarizer was a very useful arrangement, and deserved to be better known. These were things which in the old days were brought forward as "dodges." He was glad Mr. Nelson had referred to the Lieberkühn, which, in his own opinion, had been too much neglected, though there was hardly anything better for opaque illumination, with low and medium powers. It was hardly possible nowadays to get fine Lieberkühns for use with the lower power aplanatics of the long tube series. The address, to which they had just had the pleasure of listening, was one which could be well and profitably studied by the members at their leisure.

Mr. Michael having put the motion to the meeting, it was carried by acclamation.

The President thanked the members for the very kind way in which they had received his small effort to interest them on the occasion; he only hoped that he might be able still better to merit their confidence in the future.

Mr. Croger moved that the best thanks of the Club be given to the Auditors and Scrutineers for their services. That the Scrutineers had actively and efficiently performed their duties was a fact which had been demonstrated before them. And in those days of dangerous finance it was no small thing to have Auditors whose duties were so well carried out.

Mr. T. F. Smith having seconded the motion, it was put to the meeting by the President and carried unanimously.

Mr. T. C. White said the pleasing duty devolved upon him of proposing a cordial vote of thanks to the Officers and Committee. Having been an officer himself he knew something of the amount of labour which was involved in carrying out all the matters which required to be attended to in managing a society like that, and if they looked at the report which had been presented that evening they would see that the efforts of the Committee had not been in vain. When they considered what was meant by organizing the excursions, the ordinary meetings,

and the gossip nights, they would agree that those who formed their executive deserved the very warmest thanks which could be given to them.

Mr. Richard Smith having seconded the motion, it was put to the meeting and carried unanimously.

Mr. Karop said that it seemed to devolve upon him to return thanks on behalf of himself and his colleagues. He could only say that they felt gratified at this expression of appreciation of their efforts on behalf of the Club, though he believed they had always regarded their work as a very great pleasure. Two of their officers were veterans in the service. Mr. Lewis had held office ever since the formation of the Club, and Mr. Alpheus Smith had done so for 17 years, and he believed he himself came next with 11 years' service. He was sure, however, that so long as any of them held office they would do their best to promote the interest and well being of the Club.

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TWENTY-EIGHTH ANNUAL REPORT OF THE COMMITTEE.

In presenting the twenty-eighth Annual Report your Committee regrets to announce that the universally prevailing depression has not been without effect on the affairs of the Club.

In the first place there has been a considerable diminution in the number of new members joining the Club, 29 as against 52 in the previous year. Twenty-four resignations and five deaths have been notified, and twelve names have been removed from the list whose present address cannot be found, and who are, for the most part, in arrear with their subscriptions. This reduction leaves the present number of ordinary members on the books at 341 up to the end of the year 1893.

In other respects the efficiency of the Club has been fully maintained; the meetings have been well attended and the matter submitted at them, although not large in quantity, quite up to the usual standard.

The following is a list of the more important papers :—

January 20th.—"On *Callidina pusilla* and *C. cornigera*," by Mr. D. Bryce. "On the preservation of Rotifers," by Mr. C. Rousselet. "On a sample of diatomaceous earth from Guatemala," by Dr. A. M. Edwards.

February 17th.—The President's Address, by Dr. W. H. Dallinger, F.R.S.

March 17th.—"On a new Rotifer discovered by Mr. Hood, of Dundee," by Mr. Western. "On a species of Tick," etc., etc., by Mr. R. T. Lewis.

April 21st.—"On *Metopidia parvula*" (sp. n.), by Mr. Bryce.

May 19th.—"Recent work in Marine Algæ," by Mr. T. H. Buffham.

June 16th.—"On some new Rotifers," by Mr. J. Hood. "On the Antheridia, etc., of some Floridiæ," by Mr. T. H. Buffham.

October 20th.—"On *Copeus pachyurus*" (male), by Mr. Dixon-Nuttall.

November 17th.—"On some Bees' Nests from S. Africa," by Mr. R. T. Lewis. "On *Floscularia cucullata*," by Mr. J. Hood. "On *Cysticercus quadricurvatus*," by Mr. T. B. Rosseter.

December 15th.—"On the Metamorphoses of Insects," by Prof. Lowne. "On the intercostals of *P. angulatum*," by Mr. T. F. Smith.

Your Committee has had under consideration the advisability of holding a Special Exhibition meeting during the coming season. They are quite convinced of the value of such meetings. Not only are they believed to be much appreciated by actual members, but they serve to attract attention to the aims of the Club, and so are a means of acquiring new recruits. At the same time they cannot be held without expense, and the Committee on the two previous occasions had decided that the finances of the Club should not be drawn upon for the purpose. They hardly feel justified, however, in again taxing the liberality of those members who then so generously came forward with subscriptions, and as the meeting is intended to benefit the Club generally, they have decided that the necessary expenses shall be provided from the monies in hand. They trust the members will, as they always have hitherto, do everything in their power by attendance and exhibition to make the meeting a success.

It will be held on Friday, May the 4th, at Freemasons' Tavern, and notice will be sent to all members in due course.

Two journals have been issued since the last report under the editorship of the President, Mr. Nelson. The usual features have been retained, with the exception that the covers have been let for advertisements, as was done many years previously. These will be strictly limited to instruments, books, or material, and your Committee trust this innovation may be useful to some members as well as a small addition to the creditor side of the balance-sheet.

The following is a list of the books and periodicals acquired by purchase or exchange since the last report :—

	Presented by—
"Sherborn's Bibliography of the Foraminifera"	The President.
"Lovibond's Measurement of Light and Colour Sensations"	The Author.

T. Charters White's "The Microscope" (New Edition)	The Author
"Braithwaite's British Moss-Flora" (Part XV.)	"
"Journal of the Royal Microscopical Society"	Presented.
"Proceedings of the Royal Society"	"
"American Botanical Gazette"	In Exchange.
"American Monthly Microscopical Journal"...	"
"The Microscope"	"
"La Nuova Notarisia"	"
"Le Diatomiste"	"
"International Journal of Microscopy" ...	"
"Essex Naturalist"	"
"Proceedings of the Geological Association"...	"
"Buckler's Larvæ of British Moths and Butterflies" (Vol. V.)	Ray Society's Subscription.
"Quarterly Journal of Microscopical Science"...	Purchased.
"Annals and Magazine of Natural History" ...	"
"Grevillea"	"

Proceedings of various Societies.

After fourteen years of service our Curator, Mr. C. Emery, has felt it necessary to resign the post which he has filled so efficiently, and the Committee desire to offer the sincere thanks of the Club to him for the time and trouble he has so freely placed at its disposal during this long period. Mr. E. T. Browne has kindly undertaken the duties of the curatorship, and the Committee has no doubt whatever but he will carry them on as successfully as his predecessor. The catalogue of preparations is under revision, but no date can at present be assigned for its completion.

The finances have been looked after by the esteemed Treasurer, Mr. Vezey, with his accustomed ability and energy. Partly owing to the causes mentioned at the beginning of this Report, the receipts under the several heads have been smaller than those of last year; but it must be remembered in comparing the two balance-sheets that the item for subscriptions last year was exceptionally large owing to the collection of a considerable amount of arrears, and the receipts from sale of Journal were also much larger than usual, due to a recounting of stock.

Your Committee feeling they could not rely on such large

receipts during the past year, endeavoured to keep the expenses as low as possible, and although the cost of the Journal has rather exceeded the limit which had been assigned to it, yet the other items of outlay have been so kept within bounds that the Club is able to close its financial year with a somewhat larger balance than it did at the end of 1892.

This is so far satisfactory, but it should be borne in mind that a diminution of income is to be expected in the coming year owing to the large number of withdrawals, which now take effect as far as finance is concerned.

Your Committee begs to thank the officers for their continued services.

In conclusion, your Committee trusts that the adverse influences which have somewhat militated against the prosperity of the Club in the past will give way during the present year, and that all who have its welfare at heart will do whatever lies in their power to increase its numbers, promote its interest, and preserve its utility.

QUEKETT MICROSCOPICAL CLUB.

Statement of Accounts for the Year ending 31st December, 1893.

Dr.

	£	s.	d.
To Balance from 1892	201	18	1
„ Subscriptions received in 1893	162	10	6
„ One Compounding Fee	10	0	0
„ Dividends on Investment	3	19	0
„ Sale of Journal	12	4	10
„ Receipts for Advertisements	3	12	6
	£394	4	11

Cr.

	£	s.	d.
By Rent of Rooms and Bookcases	54	12	0
„ Expenses of Journal	111	10	6
„ Postage	3	18	0
„ Printing and Stationery	4	2	7
„ Attendance	6	0	0
„ Subscription to Owen Memorial	1	1	0
„ Petty Expenses, including Insurance	2	2	6
„ Books, etc., Purchased	4	16	0
„ Balance at Bank	206	2	4
	£394	4	11

Moneys invested in £2 15s. Per Cent. Consols, £143 13s. 9d.

J. J. VEZEY,
Hon. Treasurer.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify the same to be correct.

JAS. D. HARDY,
W. INGRAM CHAPMAN, } Auditors.

OFFICERS AND COMMITTEE.

(Elected February, 1894.)

President.

Edward Milles Nelson, F.R.M.S.

Vice-Presidents.

Rev. W. H. Dallinger, D.Sc., F.R.S., F.R.M.S., &c.
Prof. B. T. Lowne, F.R.C.S., F.L.S., &c.
A. D. Michael, Pres.R.M.S., F.L.S., &c.
Prof. C. Stewart, M.R.C.S., Pres.L.S., F.R.M.S., &c.

Committee.

H. Morland.
E. Dadswell, F.R.M.S.
J. G. Waller, F.S.A.
F. A. Parsons.
F. W. Hembry, F.R.M.S.
G. Western, F.R.M.S.
E. T. Newton, F.R.S., F.G.S.
J. E. Ingpen, F.R.M.S.
G. Mainland, F.R.M.S.
B. W. Priest.
J. W. Reed.
J. Spencer, F.R.M.S.

Hon. Treasurer.

J. J. Vezey, F.R.M.S., 21, Mincing Lane, E.C.

Hon. Secretary.

G. C. Karop, M.R.C.S., F.R.M.S., 198, Holland Road, Kensington, W.

Hon. Sec. for Foreign Correspondence.

C. Rousselet, F.R.M.S., 27, Great Castle Street, Regent Street, W.

Hon. Reporter.

R. T. Lewis, F.R.M.S., 4, Lyndhurst Villas, The Park, Ealing, W.

Hon. Librarian.

Alpheus Smith,
8, Hanover Park, Peckham, S.E.

Hon. Curator.

E. T. Browne, F.R.M.S.,
141, Uxbridge Road, W

Q.M.C. EXCURSIONS, 1893.

March 25th.

List of Objects Found on the Excursion to Snaresbrook, by Messrs. Burton, Parsons, Rousselet, Scourfield, and Western.

CRYPTOGAMIA. *ALGÆ.*

Batrachospermum moniliforme.
Gonium pectorale.
Staurospermum viride=Staurocarpus gracilis, in conjugation.
Volvox globator.

Desmidiaceæ.

Closterium moniliferum.
„ *setaceum.*
Hyalotheca dissiliens.
Micrasterias rotata.

PROTOZOA.

Actinophrys sol.
Arcella vulgaris.
Ceratium divergens.
Dinobryon sertularia.
Gymnodinium fuscum.
Stentor niger.
„ *polymorphus.*
Trachelius ovum.

VERMES. Rotifera.

Anuræa valga.
Asplanchna priodonta.
Brachionus pala.
„ *rubens.*
Conochilus volvox.
Copeus caudatus.
Diglena forcipita.
Dinocharis pocillum.
„ *tetractis.*
Euchlanis triquetra.
Floscularia campanulata.
„ *cornuta.*
„ *edentata.*
„ *ornata.*
Furcularia longiseta.
Mastigocerca bicornis.
„ *elongata.*
Melicerta conifera.
„ *ringens.*
Metopidia acuminata.
„ *lepadella.*
Monostyla lunaris.
Notops brachionus.
„ *hyptopus.*
Notholca acuminata.
Notommata brachyota.
Polyarthra platyptera.
Pompholyx sulcata.
Rhinops vitrea.
Rotifer macrurus.
„ *tardus.*

Rotifer vulgaris.
Sacculus viridis.
Stephanoceros Eichhornii.
Synchæta pectinata.
,, *tremula.*
Taphrocampa annulosa.

CRUSTACEA. Entomostraca.

Bosmina longirostris.
Canthocamptus minutus.
Chydorus sphæricus.
Cyclops bicuspidatus.
Cyclops fimbriatus.
,, *languidus.* New to Britain.
Cyclops serrulatus.
,, *signatus.*
,, *simplex*=*C. Scourfieldi.*
,, *strenuus.*
,, *Thomasi.*
,, *viridis,* var. *brevicornis.*
,, ,, var. *gigas.*
Cypria serena.
Daphnia pulex.
Diaptomus gracilis.
Macrothrix laticornis.
Peracantha truncata.
Simocephalus vetulus.

Attendance: Twenty-six members of the Club, six members of other Societies, and two visitors. Total, 34.

April 8th.

Objects Found on the Excursion to Totteridge, by Messrs. Burton, Parsons, Rousselet, and Southon.

PROTOZOA.

Amphileptus flagellatus.
Anthophysa vegetans.
Condylostoma stagnale.
Dinobryon sertularia.
Epistylis flavicans.
Euglena viridis.
Gymnodinium fuscum.
Stentor polymorphus.
Vaginicola crystallina.

VERMES. Rotifera.

Anuræa aculeata.
,, *brevispina.*
Anuræa cochlearis.
Brachionus angularis.
,, *pala.*
,, *quadratus.*
,, *urceolaris.*
Cœlopus brachyurus.
Copeus pachyurus.
Dinocharis pocillum.
Eosphora aurita.
Floscularia cornuta.
Hydatina senta.
Mastigocerca stylata.
Melicerta ringens.

Monostyla cornuta.
Notommata saccigera.
Notops brachionus.
,, *hyptopus.*
Polyarthra platyptera.
Rhinops vitrea.
Sacculus viridis.
Salpina spinigera.
Stephanoceros Eichhornii.
Synchæta pectinata.
,, *tremula.*
Taphrocampa annulosa.
Triarthra breviseta.
,, *longiseta.*
,, *mystacina.*

Attendance: Nine members of the Club and one visitor. Total, 10.

April 22nd.

OBJECTS FOUND ON THE EXCURSION TO CHINGFORD, BY MESSRS. BURTON, DINEEN, PARSONS, ROUSSELET, SCOURFIELD, SOUTHON, AND WESTERN.

PROTOZOA.
Amphileptus flagellatus.
Coleps hirtus.
Condylostoma stagnale.
Euglena viridis.
Glenodinium cinctum.
Gymnodinium fuscum.
Gyrocoris oxyura.
Paramecium aurelia.
Stentor niger.
,, *polymorphus.*
Trachelius ovum.
Vorticella nebulifera.
VERMES. ROTIFERA.
Actinurus neptunius.
Anuræa aculeata.
,, *acuminata.*
,, *brevispina.*
,, *curvicornis.*
,, *serrula a.*
Anuræa stipitata.
,, *tecta.*
Brachionus angularis.
,, *pala.*
,, *quadratus.*
,, *rubens.*
,, *urceolaris.*
,, ,, var.
Cathypna luna.
,, *rusticula.*
Conochilus volvox.
Diaschiza Hoodii.
,, *pæta.*
Diglena biraphis.
Dinocharis pocillum.
Eosphora aurita.
Euchlanis dilatata.
,, *hyalina.*
,, *pyriformis.*
,, *triquetra.*

Euchlanis uniseta.
Floscularia cornuta.
Furcularia gracilis.
,, *longiseta.*
Mastigocerca carinata.
,, *lophoessa.*
Metopidia lepadella.
,, *oxysternum*, without eyes.
,, *solidus.*
Noteus quadricornis.
Notholca acuminata.
Notommata aurita.
,, *brachyota.*
,, *lacinulata.*
Notops hyptopus.
Polyarthra platyptera.
,, *platyptera*, a small oval variety.
Philodina citrina.
Pterodina patina.
Rhinops vitrea.
Rotifer tardus, var. ? colourless, nearly free from mucus and dirt, toes somewhat longer than usual.
Rotifer vulgaris.
Salpina brevispina.
,, *mucronata.*
,, *mutica.*
Scaridium longicaudum.
Synchæta pectinata.
,, *tremula.*
Triarthra breviseta.
GASTROTRICHA.
Dasydytes goniathrix.
CRUSTACEA. ENTOMOSTRACA.
Bosmina longirostris.
Canthocamptus minutus.
Chydorus sphæricus.
Cyclops bicuspidatus.
,, *languidus.*
,, *serrulatus.*
,, *simplex.*
,, *tenuicornis.*
,, *Thomasi.*
,, *viridis*, var. *brevicornis.*
,, *viridis*, var. *gigas.*
Cypria serena.
Daphnia pulex.
Diaptomus gracilis.
Eurycercus lamellatus.
Peracantha truncata.
Simocephalus vetulus.
ARACHNIDA. ARCTISCONIDÆ.
Macrobiotus Hufelandii.
INSECTA. DIPTERA.
Corethra plumicornis, larvæ of.

Attendance: Nineteen members of the Club.

May 6th.

Objects Found on the Excursion to the Gardens of the Royal Botanic Society of London, by Messrs. Burton, Parsons, Rousselet, Scourfield, Percy Thompson, and Western.

PROTOZOA.

Actinophrys sol.
Arcella aculeata.
Carchesium polypinum.
Epistylis anastatica.
,, *flavicans.*
Opercularia nutans.
Ophrydium sessile.
Stentor polymorphus.
Trachelius ovum.
Vorticella nebulifera.
Zoothamnium arbuscula.

PORIFERA.

Spongilla fluviatelis.

CŒLENTERATA. Hydrozoa.

Polyp. of *Limnocodium Sowerbii.*

VERMES. Rotifera.

Actinurus neptunius.
Anuræa aculeata.
,, *cochlearis*, var.
Asplanchna Brightwellii.
,, *priodonta.*
Brachionus angularis.
,, *pala*, var. *amphiceros*, ♂ ♀.
,, *urceolaris.*
Euchlanis deflexa.
Floscularia campanulata.
,, *longicaudata.*
,, *ornata.*
Furcularia forficula.
Limnias annulatus? with seven dorsal knobs (see last year's list).
Limnias ceratophylli.
Melicerta ringens.
Notholca acuminata.
,, *scapha.*
Notommata aurita.
Œcistes crystallinus.
,, *intermedius.*
,, *longicornis.*
,, *stygis*, var.
Philodina citrina.
,, *erythrophthalma.*
,, *megalotrocha.*
Proales petromyzon.
Pterodina patina.
Rotifer macroceros.
,, *tardus.*
,, *vulgaris.*
Stephanoceros Eichhornii.
Stephanops unisetatus.
Synchæta pectinata.
,, *tremula.*

ANNELIDA. Oligochæta.

Dero furcata.

CRUSTACEA. Entomostraca.

Bosmina longirostris.
Canthocamptus minutus.
Chydorus globosus.
,, *sphæricus.*
Cyclops bicuspidatus.

Cyclops serrulatus.
,, *simplex.*
,, *tenuicornis.*
,, *vicinis.*
,, *viridis*, var. *gigas.*
Cypria opthalmica.
Diaptomus gracilis.
Ilyocryptus agilis. Found in the Victoria Regia Tank. It has not been previously recorded in Britain.
Ilyocryptus sordidus.
Leydigia acanthocercoides.
Simocephalus vetulus.
MOLLUSCOIDA. Polyzoa.
Fredericella sultana.
Paludicella Ehrenbergii.
Plumatella repens.

Attendance: Thirty-three members of the Club, twenty-eight members of other Societies, and eight visitors. Total, 69.

May 27th.

Objects Found on the Excursion to Staines, by Messrs. Burton, Parsons, Rousselet, Turner, and Western.

CRYPTOGAMIA. *ALGÆ.*
Pediastrum Boryanum.
Polyedrium longispinum.
Scenedesmus quadricauda.
Volvox globator.
PROTOZOA.
Actinophrys sol.
Ceratium fusus.
Coleps hirtus.
Difflugia oblonga.
Dinobryon sertularia.
Gymnodinium fuscum.
Loxophyllum meleagris.
Ophrydium versatile.
Stentor niger.
,, *polymorphus.*
Stichotricha remex.
VERMES. Rotifera.
Anuræa aculeata.
Anuræa cochlearis.
Asplanchna Brightwellii.
,, *priodonta.*
Brachionus angularis.
,, *Bakeri.*
,, *pala*, var. *amphiceros*, ♂ ♀.
,, *rubens.*
Cathypna luna.
Cœlopus porcellus.
Colurus bicuspidatus.
Copeus cerberus.
,, *pachyurus.*
Diglena aquila.
Distyla lipara.
Euchlanis deflexa.
,, *dilatata.*
,, *hyalina.*
,, *parva.*

Euchlanis triquetra.
Floscularia ambigua.
„ *campanulata.*
„ *cornuta.*
„ *ornata.*
Furcularia longiseta.
Mastigocerca bicristata.
„ *carinata.*
„ *elongata.*
„ *rattus.*
Melicerta ringens.
„ *tubicolaria.*
Metopidia lepadella.
Noteus quadricornis.
Notommata aurita.
„ *lacinulata.*
Notops hyptopus.
Œcistes crystallinus.
„ *pilula.*
„ *socialis.*
Philodina citrina.
Polyarthra platyptera.
Pompholyx complanata.
Proales parasita.
Pterodina patina.
„ *reflexa.*
Rotifer macroceros.
„ *tardus.*
Sacculus viridis.
Salpina brevispina.
„ *mucronata.*
Scaridium longicaudum.
Stephanoceros Eichhornii.
Stephanops unisetatus.
Synchæta pectinata.
„ *tremula.*
Taphrocampa annulosa.
Triarthra longiseta.
Triphylus lacustris.

PLATYHELMINTHES.
Cercarian stage of a trematode worm.

MOLLUSCOIDA. POLYZOA.
Plumatella, sp.

Attendance: Thirteen members of the Club.

June 10th.

OBJECTS FOUND ON THE EXCURSION TO OXSHOTT, BY MESSRS. BURTON AND PARSONS.

PROTOZOA.
Arcella vulgaris.
Difflugia pyriformis.
Euglena acus.
Phacus longicauda.
Rhipidodendron Huxleyi.
Spirostomum ambiguum.
Stentor niger.
Stentor polymorphus.
Trachelius ovum.
Vorticella chlorostigma.

VERMES. ROTIFERA.
Anuræa aculeata.
„ *cochlearis.*
„ *curvicornis.*
Brachionus rubens.

Brachionus urceolaris.
Copeus caudatus.
,, *cerberus.*
Diglena biraphis.
Dinocharis tetractis.
Floscularia cornuta.
,, *ornata.*
Mastigocerca rattus.
Metopidia triptera.
Notommata aurita.
,, *lacinulata.*
Notops brachionus.
Œcistes crystallinus.
,, *longicornis.*
Œcistes pilula.
Polyarthra platyptera.
Proales parasita.
Rotifer citrina.
,, *macroceros.*
,, *macrurus.*
,, *tardus.*
,, *vulgaris.*
Sacculus viridis.
Synchæta tremula.
Triarthra longiseta.

GASTROTRICHA.
Dasydytes goniathrix.

Attendance: Twelve members of the Club and one visitor. Total 13.

June 24th.

Objects Found on the Excursion to Hertford Heath, by Messrs. Burton, Parsons, Rousselet, and Turner.

PROTOZOA.
Anthophysa vegetans.
Aspidisca lynceus.
Bursaria truncatella.
Coleps hirtus.
Difflugia oblonga.
,, *proteiformis.*
Gymnodinium fuscum.
Paramecium aurelia.
Phacus longicaudus.
Spirostomum ambiguum.
Stentor niger.
,, *polymorphus.*
Urocentrum turbo.

VERMES. Rotifera.
Actinurus neptunius.
Anuræa brevispina.
,, *cochlearis.*
,, *tecta.*
Brachionus angularis.
,, *Bakeri.*
,, *pala,* var. *Amphiceros.*
Cœlopus brachyurus.
,, *caudatus.*
Copeus cerberus.
,, *pachyurus.*
Diaschiza valga.
Diglena biraphis.
Dinocharis tetractis.
Euchlanis lyra.
Furcularia longiseta.

Foscularia cornuta.
Mastigocerca elongata.
Metopidia acuminata.
,, *oxysternum*, no eyes.
Monostyla cornuta.
,, *lunaris.*
Noteus quadricornis.
Notommata lacinulata.
,, *tuba* (Ehr.).
Notops brachionus.
Philodina citrina.
Polyarthra platyptera.
Pterodina patina.
Rotifer macrurus.
,, *vulgaris.*
Sacculus viridis.
Salpina marina.
,, *mucronata.*
Scaridium longicaudum.
Stephanops muticus.
Synchæta pectinata.
Triarthra breviseta.
Triphylus lacustris.

Attendance: Eleven members of the Club.

July 8th.

Objects Found on the Excursion to Woking, by Messrs. Burton, Turner, and Western.

CRYPTOGAMIA. *ALGÆ.*

Nostoc verrucosum.
Pediastrum Ehrenbergii (= *P. tetras*).
Raphidium falcatum.
Scenedesmus acutus, var. *obliquus.*
Volvox globator.

Desmidiaceæ.

Arthrodesmus convergens.
Closterium Griffithii.
,, *lunula.*
,, *setaceum.*
Cosmarium margaritiferum.
Docidium baculum.
,, *truncatum.*
Euastrum oblongum.
Staurastrum gracile.

PROTOZOA.

Actinophrys sol.
Amœba princeps.
,, *proteus.*
,, *villosa.*
Anthophysa vegetans.
Amphileptus gigas.
Arcella vulgaris.
Clathrulina elegans.
Coleps hirtus.
,, *incurvus.*
Cyrtostomum lucas (= *Bursaria vernalis*).
Dileptus folium.
Dinobryon sertularia.
Euglena viridis.
Euplotes patella.
Folliculina elegans.

Gyrocoris oxyura.
Lembadion bullinus.
Paramecium aurelia.
Phacus longicauda.
Raphidiophrys elegans.
Spiromonas distorta (= *Cyclidium distortum*).
Spirostomum ambiguum.
Stentor polymorphus.
Trachelius olor, var. *viridis.*
Uroleptus piscis.

VERMES. ROTIFERA.

Anuræa cochlearis.
,, *curvicornis.*
,, *hypelasma.*
Brachionus pala, var. *amphiceros.*
,, *rubens.*
,, *urceolaris.*
Cathypna luna.
Cælopus porcellus.
Colurus bicuspidatus.
Conochilus volvox.
Copeus pachyurus.
Diglena forcipita.
Dinocharis pocillum.
Distyla flexilis.
Eosphora näis.
Euchlanis dilatata.
,, *macrurus.*
Floscularia ornata.
Furcularia ensifera.
,, *forficula.*
,, *gracilis.*
,, *longiseta.*
Hydatina senta.
Limnias ceratophylli.
Mastigocerca carinata.
Melicerta ringens.
Microcodon clavus.
Notommata tripus.
Œcistes brachiatus.
Philodina citrina.
Polyarthra platyptera.
Proales petromyzon.
,, *sordida.*
Rotifer macrurus.
,, *Rœperi.*
,, *tardus.*
,, *vulgaris.*
Sacculus viridis.
Salpina brevispina.
Scaridium longicaudum.
Stephanoceros Eichhornii.
Stephanops lamellaris.
,, *unisetatus.*
Triarthra longiseta.

GASTROTRICHA.

Chætonotus larus.
Dasydytes fusiformis.

CRUSTACEA. ENTOMOSTRACA.

Canthocamptus minutus.
Daphnia reticulata.
Polyphemus pediculus.
Sida crystallina.

MOLLUSCOIDA. POLYZOA.

Cristatella mucedo.
Paludicella Ehrenbergii.
Plumatella repens.

Attendance: Four members of the Club.

July 22nd.

Objects Found on the Excursion to Richmond Park, by Messrs. Burton, Parsons, Rousselet, Scourfield, and Western.

CRYPTOGAMIA. *ALGÆ.*
Oscillaria tenuis.
Pandorina morum.
Pediastrum Ehrenbergii (= *Tetras*).
,, *pertusum.*
Prasiola calophylla.
Scenedesmus acutus, var. *obliquus.*
,, *quadricauda.*
Volvox globator.

Desmidiaceæ.
Closterium lunula.

PROTOZOA.
Actinophrys sol.
Bursaria truncatella.
Dinobryon sertularia.
Euglena viridis.
Loxophyllum meleagris.
Ophrydium versatile.
Stentor polymorphus.
Trachelius ovum.

VERMES. Rotifera.
Anuræa aculeata.
,, *cochlearis.*
Brachionus dorcas.
Cœlopus porcellus.
Conochilus dossuarius.
Dinocharis pocillum.
,, *tetractis.*
Euchlanis deflexa.
,, *macrurus.*
,, *triquetra.*
Floscularia ambigua.
Floscularia campanulata.
,, *cornuta.*
,, *regalis.*
Furcularia longiseta.
Limnias ceratophylli.
Melicerta ringens.
Noteus quadricornis.
Notommata aurita.
Notops clavulatus.
Œcistes mucicola.
Pedalion mirum.
Philodina citrina.
Polyarthra platyptera.
Proales tigridia.
Pterodina patina.
Rotifer macroceros.
,, *vulgaris.*
Scaridium longicaudum.
Stephanoceros Eichhornii.
Stephanops cirratus.
Synchæta pectinata.
,, *tremula.*

CRUSTACEA. Entomostraca.
Acroperus harpæ.
Alona guttata.
Bosmina longirostris.
Camptocercus macrurus.
Canthocamptus trispinosus.
Ceriodaphnia megops.
,, *quadrangula.*
Chydorus sphæricus.
Cyclops diaphanus (new to Britain).

Cyclops hyalinus (= *C. Scourfieldi*, var., Brady).
,, *magnoctavus.*
,, *serrulatus.*
,, *signatus.*
,, *simplex.*
,, *tenuicornis.*
,, *viridis*, var. *gigas.*
Cypridopsis vidua.
,, *villosa.*
Daphnella brachyura.
Daphnia longispina.
Daphnia pulex, var. *Schödleri.*
Diaptomus gracilis.
Eurycercus lamellatus.
Notodromas monacha.
Peracantha truncata.
Pleuroxus uncinatus.
Polyphemus pediculus.
Scapholeberis mucronata.
Sida crystallina.
Simocephalus vetulus.
INSECTA. Diptera.
Larvæ of *Simulium*, sp.

Attendance: Nine members of the Club, one member of the South London M. and N. H. Society, and one visitor. Total, 11.

September 9th.

Objects Found on the Excursion to Keston, by Messrs. Burton, Parsons, Turner, and Western.

CRYPTOGAMIA. *ALGÆ.*
Batrachospermum moniliforme.
PHANEROGAMIA.
Drosera rotundifolia.
PROTOZOA.
Amphileptus flagellatus.
Bursaria truncatella.
Ceratium longicorne.
Phacus longicaudus.
VERMES. Rotifera.
Anuræa cochlearis.
,, *tecta.*
Asplanchna priodonta.
Brachionus angularis.
,, *Bakeri.*
,, *urceolaris*, from dry mud.
Conochilus dossuarius.
Conochilus unicornis.
Diglena forcipita.
Floscularia longicaudata.
Mastigocerca bicornis.
Monocerca rattus.
Noteus quadricornis.
Pedalion mirum.
Polyarthra platyptera.
Proales felis.

Rattulus bicornis.
Salpina mucronata.
Synchæta pectinata.
Triarthra longiseta.

CRUSTACEA. ENTOMOSTRACA.
Bosmina longirostris.
Canthocamptus minutus.
Chydorus sphæricus.
Diaptomus castor.

Attendance: Nine members of the Club and one member of the South London M. and N. H. Society. Total, 10.

September 23rd.

OBJECTS FOUND ON THE EXCURSION TO WHITSTABLE.

PROTOZOA.
Noctiluca miliaris.
PORIFERA.
Grantia ciliata.
„ *compressa.*
Leucosolenia botryoides.
CŒLENTERATA. HYDROZOA.
Coryne vaginata.
Sertularia cupressina.
„ *pumila.*
Syncoryne Sarsii?
ECHINODERMATA.
Solaster papposa.
VERMES. ROTIFERA.
Monura colurus.
CRUSTACEA.
Caprella linearis.
Crangon vulgaris.
Gammarus locusta.
Munna Whiteana.
Pandalus annulicornis.
Phoxochilus spinosus.
Stenorhyncus tenuirostris.
CIRRIPEDIA.
Balanus balanoides and larvæ of ditto.
ARACHNIDA. ACARINA.
Halacharus notops.
MOLLUSCOIDA. POLYZOA.
Amathia lendigera.
Bicellaria ciliata.
Bowerbankia pustulosa.
Notamia bursaria.
Pedecellina cernua.
Scrupocellaria scruposa.
Valkeria uva, form *cuscuta.*
TUNICATA.
Perophora Listeri.

Attendance: Eight members of the Club and six members of the South London M. and N. H. Society and the East Kent N. H. Society. Total, 14.

October 7th.

OBJECTS FOUND ON THE EXCURSION TO WOOD STREET, BY MESSRS. BURTON, ROUSSELET, AND SCHERREN.

CRYPTOGAMIA. *ALGÆ.*

Gonium pectorale.

Volvox globator.

DESMIDIACEÆ.

Closterium lunula.

Micrasterias rotata.

PROTOZOA.

Arcella vulgaris.

Condylostoma stagnale.

Euglena viridis.

Litonotus fasciola.

Phacus longicaudus.

VERMES. ROTIFERA.

Anuræa brevispina.

„ *curvicornis.*

„ *tecta.*

Brachionus angularis.

„ *pala.*

„ *urceolaris.*

Diaschiza globata.

Diglena catellina.

Euchlanis macrurus.

Euchlanis subversa = *Diplois propatula.*

„ *triquetra.*

Melicerta ringens.

Notommata aurita.

Notops brachionus.

Polyarthra platyptera.

Rhinops vitrea.

Rotifer vulgaris.

Salpina mutica.

Synchæta pectinata.

„ *tremula.*

Triarthra longiseta.

CRUSTACEA. ENTOMOSTRACA.

Bosmina longirostris.

Canthocamptus minutus.

Chydorus sphæricus.

Cypris tristriata.

Daphnella Wingii.

Eurycercus lamellatus.

Ilyocryptus sordidus.

Attendance: Ten members of the Club and one member of the South London M. and N. H. Society. Total, 11.

This year has been remarkable for the long continued drought, many ponds being dried up by the middle of the season.

FREDK. A. PARSONS,
Hon. Sec. Excursions Sub-Committee.

Observations on Amœbæ.

By Henry W. King.

(*Read March 16th, 1894*).

Plates XIX., XX.

Since communicating to this Society in a former paper the habits of some forms of pond life from the West Indies, opportunities have occurred to me for further observations on some of the life brought in the two dippings then referred to from Port Limon and the Island of Colon.

Though some species of Vorticella, Epistilis, and Mellicerta only lived a brief period after arriving, other forms grew and multiplied apparently as naturally in small vessels of water, when the temperature on several occasions fell below freezing point, as they would in their native climate and habitat, thus illustrating by their insusceptibility to varying temperatures how wide may be the range of the distribution of such forms.

And the tendency of a wide distribution with all the diversified influences which such would give is conducive to ever-increasing diversity of living forms, of living action, ever applicable alike to the most complex and most lowly.

Among the many interesting forms of life in the before-mentioned and subsequent dippings from Colon and Port Limon were well-defined forms of Amœbæ showing distinct habit attributes, evidently acquired through widely differing influences.

While observations of Amœbæ illustrate how changeful individual Amœbæ are, comparisons with different forms show that specially acquired attributes are observable in the different kinds; in fact, all varieties appear to have differentiated a normal form and normal habit, subject like all life to variations through the influence of diversified surroundings.

Amœbæ, like some of the higher micro-life, are often very active when first examined under the microscope, and they will sometimes continue so, gliding and searching among the confervæ

or sedimentary matter that induced their search for many hours and often days, and then as the environment of the beings becomes abnormal, like a fly caged in a glass box, they will slowly show signs of decreasing and unnatural action, as if a comatose condition was passing over them, and finally they assume an encysted state, when all co-ordinate vital action is suspended. Should a fresh supply of the native water they were living in be added, they regain their normal condition, and move and glide restimulated to natural life.

A most interesting form of these organisms of a low type of development compared with *Amœba radiosa* or *A. princeps*, which I propose naming *Amœba endo-divisa* (Fig. 1, Pl. XIX.), was living in the dipping from Colon. It was of a very pale straw colour, of a film-like nature, and nearly transparent. It had an almost perfect pear-shaped outline, which was its normal form when not exteriorly influenced, but when passing among small particles of matter in the water it would contract in order to pass between the obstructions. When it freed itself it would expand to its normal form, and continue gliding as if searching among the matter there for food, evidently showing selective attributes as other low Protozoa will do. Some—"like the malarial—live in the plasma on red-blood corpuscles; there are other Protozoa that infest the tissues of the body, some *preferring* the muscles, some the connective tissue, others again the nervous system" ("Brit. Med. Journ.," Vol. ii., p. 825, 1893). Sometimes a portion of the almost transparent ectosarc of this Amœba would be protruded and retracted again, and then another process would be extended in a different direction, in a manner common to such attributes in Amœbæ. The extension and retraction of the ectosarc goes on simultaneously with the motion of the Amœba, and several different impulses may influence the organism at the same time. One impels it to travel, another to select, and another to attach itself, while other impulses influence circulation and minor internal movements. Whatever motion the ectosarc may take, and however contracted the being becomes, it always returns to its normal outline. A peculiarity of the structure of this Amœba is that the endosarc does not assume a diffused arrangement, but from a small spheroidal mass at the narrow end of the Amœba the endosarc is elongated into several finger-like rays, extending nearly the whole length of the animal. These rays of the endosarc when compressed

together (Fig. 3, Pl. XIX.), as frequently happens by the contraction of the animal, return to their normal rayed or divided appearance when the contraction is withdrawn. The endosarc is faint, and only a little more marked in colour and consistency than the ectosarc.

I was unable to discern any nucleus or vacuoles, and the protoplasms were free from granules and extraneous matter.

In the specimens I observed there was no indication of any diatoms or desmids or food usually found in Amœbæ.

By this it would seem the food is of a different nature to that selected by Amœbæ in general. And the endosarc occupying so small a proportion of the whole being, and having so divided a position within it, it does not seem possible that bodies such as diatoms could be digested there, as only very minute organic food appears capable of being enclosed in it.

It is possible that this Amœba may assimilate nutritive matter in quite a different mode to that adopted by other and more highly differentiated forms. Instead of absorbing solid and living matter to be digested in the endosarc as in a stomach, they may absorb nutriment in solution in the water in which they live. The abeyant development of the endosarc may by this be accounted for.

This Amœba glides very quickly like a film over sedimentary matter, to which it invariably travels, as by some attraction, and, though apparently scarce, and not easily seen in consequence of its flatness and transparency, it may be in reality very numerous among the sedimentary matter in the water. And more, it is possible that its real home is lower in the sediment, deeper in the ever-increasing refuse falling from animal and vegetable life domiciled near the tropical pool. And fluids charged with decomposing ingredients would readily reach these organisms living among the interstices of the flocculent matter that forms at once their home and their source of food. Specimens of *Amœba radiosa* (Fig. 4, Pl. XIX.) were also in the dipping from Colon, as well as in the dippings from Port Limon and St. Lucia.

It is interesting to note the wide distribution these animalcules have, and more marked in extent than any of the other forms mentioned in this paper. This may be accounted for by this form living principally upon and among the flocculent sediment to be found in the water, where the long pseudopodia are well adapted to pass among the interstices of the sediment, and there find support

and means of obtaining food, and by the agency of wading birds unconsciously conveying small particles of mud containing these Amœba, adhering to their feet, from one pond to another, and so diffuse them from island to island. It is a well-known fact that wading birds migrate great distances, and they are, no doubt, great distributors of microscopic aquatic life.

Amœba radiosa is a very special form, and moves about with its long rigid pseudopodia that often act as adhesive disc-like feet (Fig. 5, g.g., Pl. XIX.) on the glass and cover-glass, and seem to partially draw the animalcule along, and sometimes the Amœba is suspended, fixed by one of these pseudopodia, and may turn, as on a pivot, partially round. Evidently this form has here differentiated a special attribute at the extremities of the pseudopodia. This action seems to be the first exemplification in Amœbæ of another attribute, the endowment of a pseudopodium with powers of disc-like attachment, the action of which is distinct from a gliding movement or a mere travelling motion, such as is commonly to be seen in this and other forms, and which has become a co-ordinate attribute of the organism.

In the same dipping with *Amœba endo-divisa* from Colon were very active specimens of *Amœba princeps* (Fig. 7, Pl. XIX.) associated with this new form, and with which their more vigorous, deeper coloured, and powerful digestive protoplasm contrasted. As usual with these Amœbæ they are formed of very distinct protoplasms.* The more solid and internal endosarc is of a very deep yellow ochre colour, very much deeper in hue than in those specimens I have seen inhabiting waters in this country. The ectosarc is of a pale straw tint, yet this, too, shared a deeper hue. The colours are evidently liable to vary, influenced, as they no doubt are, by food and the diversified action of widely different regions upon them.

* Some observers argue that Amœbæ have but one protoplasm independent of nucleus, because the whole protoplasm stains alike, whereas staining does not show attributes, but form only. No one would suggest that woody fibre cells, secreting cells, and cellular tissue had only the same attributes, yet these in many plants all stain one colour, while these cells exemplify different attributes that imply in each special protoplasmic growth. In the "Proceedings of the Royal Society," vol. xlix, p. 194, Nature of Amœba, " Contrast of the protoplasm of cell to that of the pseudopodia, the former exhibits, according to focus, a finely punctuated or reticular aspect, whilst the pseudopodia exhibit not the faintest trace of structure—they behave different to staining reagents. The protoplasm of an amœboid cell, as of the white blood corpuscle, may be regarded as composed of two distinct substances, spongioplasm and hyaloplasm."

The specimens observed from the West Indies moved rapidly, but in a similar manner to those of the same kind I have seen inhabiting England, by protruding always the pale ectosarc, the normal outline of the pseudopodia of which are rounded at the extremity. When in motion the pseudopodia, controlled by an even impulse, flow like a film, and there is no dividing of the pseudopodia into a fringed outline as is to be seen in those specimens (Figs. 1 and 2, Pl. XX.) received in a dipping from St. Lucia.

It is possible that these different forms of Amœbæ have gradually adapted their protoplasmic action to the influence of the surroundings in the water in which they live, whether they are clayey, flocculent, or covered with the growth of algæ or other vegetation, for all these different conditions appear to induce special growth and attributes in Amœbæ, that become, under like conditions, exemplified in the different varieties as distinct fixed attributes. The different varieties have a special manner of extending their pseudopodia, of moving their whole mass, and of gliding, and the internal circulation also varies, as does the general appearance of the beings. *Amœba princeps* moves by elongating the pale ectosarc, which has functions of selecting food, of motion of touch and of adaptation. It would seem to possess special powers in these respects, and by the mingling of this form of the protoplasm with the protoplasm of the endosarc, the being is capable of like impulses over its whole formation. But the attributes of each, though each is in mingling community with the other, remain distinct, for the endosarc, with its nucleus, decidedly exemplifies attributes which the ectosarc does not possess. It is essentially the digestive and assimilative organ, and the centre of the reproductive powers. Its appearances and development vary in different kinds, as in endo-divisa, and in some marine forms it is very glassy and never shows diatom remains within it, and the ectosarc derives its nourishment from it, although the latter is the selective agent for procuring and conveying the food. Diatoms and other visible food are never long retained by the ectosarc, but are at once passed into the central denser endosarc, among the granules located there, implying that there the digestive and assimilative powers are strongest.

The endosarc never acts in a primary manner in the motion of the being, but always moves successional to the ectosarc, which has centralized in its plasma the whole of the attributes of motion as far as they are evinced in Amœbæ.

When moving, the ectosarc may, or may not be elongated into pseudopodia, and when extended to the requirements of the being the endosarc may, or may not circulate in the direction of the pseudopodia, and more sometimes in one direction than another. Vacuoles may apparently oppose the direction of the sarcode, and the current divides, passing the vacuoles as if they formed a resistance to the flow. At other times the vacuoles float with the currents impelled in the endosarc, or may be themselves passed through the sarcode, clearly indicating an attribute of retention of the vacuoles by the protoplasm, to one region of the being, or a circulation to another region, as the animal requires. The mere extension of the ectosarc does not cause the flow of the protoplasm of the endosarc, or the granules, or food it contains, as the former is frequently protruded a considerable distance, and then withdrawn into the main substance of the Amœba, without any motion whatever in the endosarc. Implying the organism had a separate control over the movements of the endosarc, and could centralize action or inaction of its plasma at any part or parts of its being, or by a co-ordination of several attributes, the organism can glide, move, select, absorb, and digest simultaneously. The movements of the hyaline ectosarc in these specimens from the West Indies is very frequent, much more so than I have observed in English forms, as though the habit of motion had become quicker by the continual stimulus of a higher temperature, and the organism glides in ever diversified forms, sometimes it is rounded, then elongating rapidly it moves like a slug, then altering its course by the absorption of the elongated ectosarc and protruding it again sideways, the animal is caused to move at right angles to its former motion, or it will sometimes flow a little way in two directions at once, as if about to divide into separate individuals, then suddenly welding into one undivided mass. In such cases accidental influences may cause a division of one into several individuals, as is commonly to be observed with numerous forms of plant and other life, which, but for accident, would never utilize their attributes for division into new centres of growth.*

* In many climbing plants the nodes have the attribute to become separate individual centres, but without power of doing so, and unless divided by accidental influence their roots become aborted, change from absorbents to mere supports, or accommodate themselves to conditions, and utilize energy in developing the community forming the plant, instead of utilizing that energy in developing individual centres for a wider sphere of growth, which would be more conducive to the welfare of the species.

In its gliding movements this Amœba passes by certain organic matters, although coming in contact with them, even particular diatoms known to be absorbed by Amœbæ, while other diatoms, other life, perhaps differently constituted, differently formed, are readily absorbed by the Amœba in question and digested in the endosarc, the remains being expelled when required by the organism, at the most convenient part. If the absorption was merely a physical absorption or physical attraction we should expect to observe any and all matters taken into the protoplasm without an exemplification of indifference to this matter or that matter for food. On the other hand these and other numerous attributes of the protoplasms of Amœbæ seem very much like sentient selective attributes, and yet we find similar actions proceeding in the absorbent cells of plants, in the absorbent cells in the higher animals, where specialized cells absorb not only that kind of nutriment most conducive to their individual well-being, but select and pass to different cells matter which the selective absorbent cells do not require, as if there was an attraction through the community of cells influencing special absorption.*

As with these, so with the protoplasms of Amœbæ ; each seems to have its specialized attributes, although in mingling circulation with the others, as individualized cells have either isolated or in community, and each protoplasm of Amœbæ is itself, with its attributes, individually amenable to influences governing adaptation, form, and habit, implying every isolated habit was an unconscious growth. It seems every form of protoplasm of Amœbæ may acquire special habits of growth and of action, as the result of a different stimulus on susceptibility to vary existing form and action, as note the different conditions in which Amœbæ are found, and the different actions of the protoplasm of like kinds under such differing circumstances evolving habits that become

* Dr. Burdon Sanderson, on Food Attraction, says, "Just as the dog-fish is attracted by food it cannot see, so the plasmodium of Badhamia became aware as if it smelled it, of the presence of its food, a particular fungus, and towards this centre streams of living material converge, soon the afflux leads to an outgrowth of the plasmodium, which in a few minutes advances towards the desired fragment, envelops and incorporates it."—"British Med. Journal," p. 616, Vol. ii., 1893. "Chemiotaxis is the term applied to this gathering together, like that of vultures to a carcass, of these migratory cells, which have their home in the blood stream, and in the lymphatic system, to any point in the living tissue of the body injured, as if the products of disintegration which are there set free were attractive to them." —*Ibid.*, 616.

permanent attributes; for I believe it to be a law in nature that a protoplasm having acquired a special habit, that that habit will remain an attribute of that protoplasm, capable of transmission by growth to new protoplasm, new cells. Every variation of action and form in the organism implies growth, the influence of which is never wholly lost, but is capable of multiplication, of reversion, or of remaining dormant until conditions recur to excite redevelopment of the variation, and any Amœba may exemplify any, or all, the attributes of Amœbæ from which it has developed. In conjugation of Amœbæ, which occasionally happens, special attributes possessed by the protoplasm of either individual before conjugation would still remain distinct in the combined individual capable by growth of further transmission. Every influence acting upon the growth of Amœbæ is not only recorded in the one Amœba by special development, by special action, but is also under like conditions evinced in Amœbæ developing from it.

The Amœba thus presents not a mere jelly mass of protoplasm moving alone by physical influences, or endowed only with such power as may develop in an individual protoplasm. But Amœbæ, according to their powers of development, evince attributes and habits implying in each special plasmic growths developed as the result of diversified conditions and influences acting on long generations of Amœba life.

Explanation of Plates.

Plate XIX.

Fig. 1. Normal gliding form of *Amœba endo-divisa*, n.s.; habitat Colon, W.I. *a.* Endosarc. *b.* Central region of endosarc. *c.* Endosarc extending through ectosarc (*d.*)

,, 2. *Amœba endo-divisa* in motion developing pseudopodia (*c.c.*)

,, 3. *Amœba endo-divisa* contracted, showing the endosarc as apparently one body.

,, 4. *Amœba radiosa* (common form), as in dippings from Colon, Pt. Limon, St. Lucia, and Trinidad. *a.* Endosarc. *b.* Nucleus. *c.* Contractile vesicle. *d.* Granules. *e.* Ectosarc. *f.* Pseudopodia without endosarc.

FIG. 5. *Amœba radiosa.* Letters as above with *g.g.*, adhesive expansions of pseudopodia.

„ 6. Another form of above.

„ 7. *Amœba princeps* from Colon. *a.* Endosarc quiescent. *b.* Nucleus. *c.* Vacuoles. *d.* Granules. *e.* Ectosarc extending without endosarc. *f.f.* Diatoms, etc., absorbed as food.

„ 8. *Amœba princeps* showing endosarc in motion with the ectosarc letters as above.

„ 9. *Amœba princeps*, another form assumed by same.

„ 10. *Amœba princeps*, encysted form with unabsorbed process of ectosarc.

„ 11. Two *Amœba princeps* conjugating.

„ 12. *Amœba princeps* discharging granules and sarcode.

In Figs. 5, 7, and 10 the nucleus is naturally contracted and shows a hyaline space around it.

PLATE XX.

FIGS. 1, 2, 3, 4, and 5. Uncertified forms of Amœba expressing different protoplasmic action, from St. Lucia, W.I. *a.* Endosarc. *b.* Ectosarc. *c.* Contractile vesicle. *d.* Diatoms taken into endosarc as food. *e.* Largely developed contractile vesicle with very thin film of sarcode over it.

FIGS. 3, 4, and 5 are probably modified forms of *Amœba princeps*, though remarkable for a rounded development of one extremity. Colour similar to ground glass.

Some Foreign Rotifers to be included in the British Catalogue.

By Geo. Western, F.R.M.S.

(Read May 18th, 1894.)

Having been informed that there is no paper to occupy our attention to-night, I have hastily put together some heterogeneous extracts from my note-book, which, although I fear from their technicality you will find rather tedious to listen to, will nevertheless, I trust, be deemed worthy of record. Firstly, as it has been suggested by Mr. Percy Thompson ("Science Gossip," Jan., 1893) that it is desirable to put on record the appearance in this country of species of Rotifers not mentioned in our text-book as indigenous to Britain, but which have been described as occurring in foreign waters, I have made a list of several such which I have met with during the past year or two. I put forward no claim to having discovered them myself, but as no one else seems to consider it worth while to mention them, I trust I shall not be considered presumptuous in bringing them to your notice.

1. *Notholca heptodon*, Perty.—This, although figured and described in Hudson and Gosse's Supplement, is only noticed as having been found at Rochdale. It is, however, a very common species round about London, notably at Staines and the Penponds in Richmond Park.

2. *Ploesoma Hudsoni*, Imhoff = *Gastroschiza flexilis*, Jägerskiold = *Bipalpus vesiculosus*, Wierz. and Zacharias = *Dictyoderma hypopus*, Lauterborn (see paper by H. Jennings in "Zool. Anzeiger" of 19th Feb., 1894).—This much-described and many-named Rotifer was sent to me from Dundee by Mr. Hood in May last year. He found it in brackish water. It is the most extraordinary Rotifer I have ever seen. Its peculiar position in swimming, the semi-loricated condition, the cellular appearance of the whole body integument, and the presence of two curious finger-like processes in the corona, with the very large wrinkled foot protruding from the centre of the gastric surface, are very distinctive features.

3. *Anapus ovalis*, Bergendal = *Chromogaster testudo*, Lauterborn = *Ascomorpha testudo*, Zacharias, is another species I received from Mr. Hood, who found it at Dundee. I have also seen it from Hertford Heath and other places near London.

4. *Œcistes socialis*, Weber.—This is quite distinct from *Œcistes mucicola*, Kellicot, which I have already described before this Club as a British species. It was also a find of Mr. Hood's, who identifies it with Weber's species. It inhabits the same alga, *Gloiotrica pisum*, and was associated with *Œ. mucicola* and *crystallinus*. The foot is very long, twice or thrice the length of body, and deeply wrinkled. It has no dorsal hook, one dorsal, and two dorso-lateral antennæ. The habit which this Rotifer has of arching itself towards the ventral aspect so that the dorsal side of the corona is upwards when expanded is a very distinctive feature. For original description see Weber's "Rotateurs des environs de Genève," Hudson's Bibliography, 199.

5. *Sacculus saltans*, Bartsch.—This also I got from Mr. Hood, who has known it long in the neighbourhood of Dundee. I have also found it near London, at Esher Common and elsewhere. It is described and figured in Hudson and Gosse's Supplement. In his article above referred to, Mr. Percy Thompson has mentioned that *Sacculus hyalinus* may also be looked upon as a British species. I have also seen a Rotifer which I have identified therewith, and so have some friends of mine, and there is, I know, an idea abroad that the two species are identical, *hyalinus* being the younger stage of the other. This is a matter which requires verification, and might possibly be cleared up by some members of this Club during the present excursion season.

6. *Brachionus dorcas*, Gosse, var. *spinosus*, Wierz., described and figured in Wierzejski's "Rotatoria Galicya."—This I have frequently found, and believe it to be only a stage in the life history of *B. dorcas*, just as *B. amphiceros* is in that of *B. pala* as stated by Hudson. Bilfinger, I see, goes further, and says *B. dorcas* is only a variety of *B. pala*. My experience is rather against this, for in a particular pond in which I constantly find *B. dorcas* they are always *dorcas* and never *pala*, whereas in the near neighbourhood are other ponds in which I find constantly *B. pala*, but never *B. dorcas*. Gosse says that he could not see the contractile vesicle in this Rotifer, *B. dorcas*. Strange to say he has put it in his figure, and correctly so, for it is always present.

7. *Brachionus-brevispinus*, Ehr., *vide* Hudson and Gosse's Supplement.

8. *Brachionus rhenanus*, Lauterborn.—Both these Rotifers are to be found at the Botanical Gardens, and Mr. Rousselet and I had arrived at the conclusion that Lauterborn's hint that they are varieties of *B. Bakeri* really expresses the truth. Bilfinger in his paper before referred to confirms this idea.

9. *Eosphora elongata*, Ehr., Hudson and Gosse's Supplement.—This is common enough, and agrees very well with the figure given. Shortwood Common, near Staines, is almost a sure place to find it.

10. *Eosphora naias*, Ehrenberg, Hudson and Gosse's Supplement.—There is some doubt as to whether this is distinct from *Notommata naias*. I often find Rotifers which are hardly distinguishable except for the eye-spots, in one case three, and in the other one only. So far as I can judge the anterior two in the Eosphora form are as perfect eye-spots as any we see in Rotifers, and I believe the two Rotifers to be distinct. Eye spots are, however, very unreliable features by which to determine either species or genera, on account of their evanescent character, in the Rotifera being often visible only in the very young animals, and disappearing altogether in adults. More than this, I have frequently found specimens of this very *Notommata naias* in which I could see no signs of eye-spot, and a very curious instance has just been brought to my notice by a friend who had a gathering of these Rotifers, which, when first he examined them, had it as usual, but in which it entirely disappeared after he had kept them a few weeks in comparative darkness.

11. *Notommata tuba*, Ehr.—This was very doubtfully included as a British species by Mr. Gosse on the authority of a rough sketch from Dr. Collins' note-book. It is undoubtedly entitled to a place in our catalogue. I have frequently found it. It was identified by Dr. Hudson himself just after the completion of his book, and I have since been able to send it to many friends, for it has frequently turned up in my aquarium, and I think always after expeditions to Staines, at which place I first found it. The original figure by Ehrenberg is the best published, but this Rotifer must be seen alive for its full beauty to be appreciated. It is, as suggested by Mr. Gosse, most closely allied to Hydatina.

12. *Seison grubei*, Claus., Hudson and Gosse's Supplement.—

The drawing of this Rotifer has long excited my curiosity, and a few weeks back it occurred to me to get some Nebalia, the marine Entomostracan, on which it is parasitic (or more correctly commensal), for examination, and on the first I looked at I found several specimens which agree very well with the figures and description given. It is certainly a Rotifer, but a most extraordinary one, and is well worth looking for. As the Nebalia came from Plymouth and the Channel Islands, this species may also be added to the British list.

Next I have one or two remarks as to the presence of antennæ or setæ. These I bring forward simply as the result of my own observations. They may be easily verified or otherwise, and I wish it to be understood that I have no desire to pose as a critic of the work already done, and well done, by our authorities on the Rotifera; I mostly refer to doubtful matters which it is desirable to clear up for the benefit of future students, and a little discussion on such points would, I think, add much to the interest of our meetings here. Pond hunters are many amongst us, but we hear too little of the results of their labours.

As to the presence of antennæ or tentacles, Dr. Hudson's note at p. 139, Vol. ii., of the Rotifera, says "they are in two pairs." This rule may be applied very generally. They are to be found in most Rotifers, and although there are a few exceptional cases, it will mostly be found that they have not been described because not particularly looked for. Again, better objectives and more perfect methods of illumination are at our disposal than when the description of many of the species was written. But in some cases it is positively stated that they are not present.

In *Lacinularia socialis*, ventral antennæ are said to be absent, though Dr. Hudson adds a note that "possibly they may be very minute setigerous pimples, which have escaped observation." They are certainly present, and fairly prominent too. How they have escaped observation so long is a mystery to me.

In *Megalotrocha alboflavicans*, in which species also they are supposed absent, they will be found a very prominent feature.

In the Œcistes the dorsal antenna, probably a double one, will almost invariably be found, although its absence is included amongst the general characters of this genus.

In *Copus cerberus* the absence of the lateral tentacles has been made a specific character, but they are invariably present, though

small, and usually hidden by the opaque dark matter in the digestive organs. I have also, by the way, frequently seen this Rotifer, when swimming, protrude auricles as large as those of any other species.

The presence or absence of setæ is also a very unreliable character, for instance, *Euchlanis lyra* is said to have none on the foot; I find them both with and without setæ, and I see Bilfinger states that his specimens had four setæ. *Philodina megalotrocha* is said to have only one seta on the antennæ. In what I believe to be that species I always find the usual bunch of setæ. In *Copeus pachyurus*, Gosse could not see the occipital antenna, but it is certainly present, and the lumbar tentacles, though said to be without setæ, will be found to have the usual bunch.

Lastly, I have one or two problems for your solution.

1. Are there not two distinct varieties (or species ?) of *Polyarthra platyptera*, viz., a large square-shaped one and a much smaller triangular-shaped one ?

2. Is the *Limnias*, with the ringed tube, which we find about London, and notably at the Botanical Gardens, really to be identified with *Limnias annulatus*, Cubitt ? The horny processes or hooks on dorsal side are seven instead of five described, or six as figured, and the distance between the rows does not correspond with the width of the rings of the tube. The tube also is always opaque in the centre, and not transparent throughout, as would appear from the figure. Does anyone know where to find the type species ?

3. What is the Œcistes with the broad corona, which has been found for years at the Botanical Gardens, and called "Umbella," "Stygis," and "Crystallinus ?" I don't consider that it agrees with either of these, all three of which I know very well. It has several peculiarities, which would, I think, justify its separation as a distinct species.

4. Is *Asplanchna* polymorphous—I mean, may we consider that the species we recognize are more than varieties in the life history of one or two species? I have a suspicion that we have still much to learn about this genus of Rotifer; I believe I have seen evidence on this subject published in some continental journal, but can we not find some for ourselves ?

5. What about a male in the *Bdelloida ?* Can no one solve this problem ?

6. Has anyone, since Gosse, noticed anything about *Proales*

parasita? It seems to me more like a Sacculus than any of the Proales. I have lately found it in quantity, free swimming, in a pond where there were no signs of Volvox.

7. What is the meaning of the development of the posterior spines of *Brachionus pala*, *Brachionus dorcas*, and *Brachionus Bakeri?* Has it any connection with the development of the ova? I had an idea that it has, but have recently seen some *B. pala* absolutely destitute of spines, and yet carrying ova, which fact rather upsets my theory.

These several questions I would suggest for your attention and solution, should opportunity offer during the present Rotifer season, and I hope that many papers will be forthcoming for our entertainment as a result thereof.

The following species have been met with since the above paper was read :—

Polychætus subquadratus, Perty (Zur Kentniss Kleinst. Lebensf., Berne, 1852).—I have found this Rotifer in some water sent me by Mr. Hood from the Black Lake, Blairgowrie, Scotland. Carl Ternetz (Rotatorien der Umgebung Basles) has shown that this species is distinct from *Dinocharis collinsii*, Gosse (Hudson and Gosse, The Rotifera), a matter which was left doubtful by Dr. Hudson. Ternetz also gives good figures and descriptions of both Rotifers, and shows reasons why Polychætus should be considered a separate genus from Dinocharis. Mr. Hood has apparently been acquainted with this Rotifer for years.

Floscularia libera, Zacharias (Forschungsberichte aus der Biol. Station zu Plöu, II., Theil, 1894.)--A small, free swimming floscule with only one lobe to the corona, and no apparent tube, but having a peculiar pear-shaped swelling on the foot; my specimen carried an egg. This also occurred in water sent by Mr. Hood, but from another locality in the neighbourhood of Dundee.

Triophthalmus dorsualis, Ehrenberg (Hudson and Gosse, The Rotifera).—On the occasion of the last excursion to Staines, I met with a Rotifer which is undoubtedly that drawn by Gosse and described as this species. Dr. Hudson's remarks as to Eckstein's description of the stomach and its glands are certainly correct, but the two eye-spots on the frontal prominences mentioned by Eckstein, and not seen by Messrs. Hudson and Gosse, were plainly visible in my example. Of the three cervical spots the centre one only is a true pigment or eye-spot, the two outer ones being chalky

deposits on the brain lobes. They show dark red by transmitted light, but their true character is manifested by flooding the field with light or by examination on a dark field. Under these circumstances the Rotifer is plainly an Eosphora, and but for the chalky deposits on the brain it has a very striking resemblance to *Eosphora digitata.*

Rotifer mento, Anderson (Notes on Indian Rotifers, Journ. Asiat. Soc., Bengal, 1889, Vol. lviii.)—Mr. H. Jennings, in his report of the Rotatoria of the great lakes of Michigan, describes a Rotifer which he identifies with this species, and in his article says, "It is of great interest to find here this form recently described from Calcutta, India. It has, I believe, not been reported since, except doubtfully, and without notes, in one of the lists of the Quekett Club collections in England" (Journ. Q. C., July, 1893, p. 276). I was very pleased to see that even the lists of Rotifers, etc., found at our excursions were deemed worthy of reference, and as I am responsible for the report in question may perhaps be permitted to say a few words in explanation of the query appended. On the particular excursion referred to I found a Rotifer (genus Rotifer) inhabiting a tube which I was fortunate enough to see it actually constructing. Examples were numerous. Mr. Jennings' description of the process and also of the animal itself, as found by him, agree remarkably with my own observations, but I was at the time, and am still, unable to satisfy myself of the identity of my Rotifer with Mr. Anderson's description of *R. mento.* I have since found it several times, and should it be the same species, this is another to be added to the British list.

Rattulus bicornis.—The error in the description of this Rotifer, which I attempted to correct in my note of 15th September, 1893 ("Q. M. C. Journal" for October, 1893, p. 308), has, unfortunately, been repeated. The description should read, "Toes unequal, substyles three."

On Distyla spinifera.

By George Western, F.R.M.S.

(*Read June 15th, 1894.*)

Plate XXI.

This is apparently an undescribed species ; I first found it last spring in some stuff taken on Putney Heath, one or two specimens only, but was unable to find more till a few weeks back, when it turned up again somewhat more abundantly, so that now with the help of Mr. Rousselet, who has prepared some slides of it, and of Mr. Dixon Nuttall, to whom I am indebted for drawings, I am able to place it on record. At first sight it rather resembles *Metopidia oxysternon*, but on closer examination the resemblance is found to be very superficial, and it proves to be a Distyla. In shape it is a long ellipse, the posterior two-thirds protected with a lorica closed behind, abruptly truncated and open in front, but continued by a stiffened membrane forming a sort of double hood for the protection of the head and neck, which are thus capable of entire retraction within the lorica proper. This is divided into two plates with a membranous lateral invagination. The dorsal plate is apparently the smaller of the two. It is depressed, and owing to the presence of a triangular ridge commencing abruptly at the junction of the anterior and middle thirds of its length, and extending almost to its posterior edge, is higher behind than in front. Other ridges and depressions give it a regular facetted appearance. The lower or ventral shield is hemispherical in transverse section, and has its lateral edges inverted to form the lower plane of the lateral inangulation. On the postero-lateral angles of the edges, one on either side, are two thorn-like spines, at the base of which are situated the lateral antennæ. This striking peculiarity, leading to the easy identification of this Rotifer, I have chosen as the origin of the specific name. The ventral surface is divided into three planes by two longitudinal ridges, extending from the ventral edge and terminating abruptly

at the junction of the middle and posterior thirds of its length, behind which the surface is deeply excavated. A large bulbous three-jointed foot, which, though retractile, is habitually protruded, emerges through an opening in the posterior part of the ventral shield. The foot ends in two long, narrow, slightly curved, and sharp pointed toes. There is a large single eye placed on a transparent brain. The occipital antenna is large and crowned with a bunch of setæ. The trophi of the usual form have four teeth on each uncus. The other internal organs present no peculiarities, and therefore require no separate notice. This Rotifer has to some extent the sleeping habits of the Cathypnadæ. I have always found it grubbing about amongst the sandy sediment at the bottom of the pond, and it has a trick of covering itself with small particles of sand, etc., which at times make it difficult to distinguish. Briefly its Specific Characters may be said to be: A facetted lorica higher behind than in front. The dorsal shield, the smaller of the two; ventral with inverted edges bearing two thorn-like spines on their postero-lateral angles. Foot large, with two long, narrow, curved, and pointed toes. Trophi with four teeth. Size $\frac{1}{120}''$. Habitat: Putney Heath.

Description of Plate XXI.

Distyla spinifera.

Fig. 1. Dorsal view of Rotifer.
,, 2. Ventral view.
,, 3. Lateral view.
,, 4. Trophi slightly crushed.

On Ilyocryptus agilis (Kurz), a Rare Mud-Inhabiting Water-Flea.

By D. J. Scourfield.

(Read June 15th, 1894.)

Plate XXII.

In May last year, upon the occasion of the Club's visit to the Royal Botanic Gardens, Regent's Park, I was very pleased to find *Ilyocryptus agilis* (Kurz) in the well-known Victoria Regia tank. This species had not been previously seen anywhere in this country, and although its occurrence in the tank does not give it a claim to be considered as British, yet since it has been recorded by at least two Continental observers it is to be expected that sooner or later it will be legitimately added to the British fauna. Under these circumstances the following short description may help to facilitate its recognition by collectors.

In general outline *Ilyocryptus agilis* (Plate XXII., Fig. 1) does not differ markedly from the normal type of the genus as exemplified, for instance, by our widely distributed and fairly common *I. sordidus*, Liévin. The head is, however, as seen from the side, rather smaller and perhaps a little more pointed than in the last-named species, while the shell is a trifle broader, being at least as broad as long, with its posterior margin almost straight. The dorsal margin, moreover, is strongly keeled. Seen from the front the animal appears more compressed than *I. sordidus*. Very noticeable points in connection with the shell of this species are its comparative cleanness and transparency, both due to the fact that the animal's successive moults are complete. This further accounts for the absence of the concentric rows of spines on the shell which are so characteristic of *I. sordidus*. The shell-sculpture consists of a very faint network of rather large hexagons, formed by lines of fine dots (Fig. 2). In the specimens I had under examination a number of small oil-globules, between the outer and inner layers of the shell-valves near their ventral margins, formed a somewhat con-

spicuous feature, but this is probably an inconstant character. The setæ fringing the ventral valve-margins are long and plumose; those arising from the hinder margins are plumose, but shorter than the former, and furnished with an accessory spine or branch seated on a small swelling (Fig. 3). This last character is by itself sufficient to distinguish *I. agilis* from *I. sordidus*, for the posterior setæ in the latter give rise to from three to five or more accessory spines. The first and second antennæ are very nearly as in *I. sordidus*, but perhaps rather more slender. The alimentary canal is, as usual in this genus, a simple tube without cæca, but with a terminal contractile dilatation in front of the rectum. The abdomen bears dorsally a single very large spur, which is hairy on its lower face. The post-abdomen (Fig. 4) is large and broad, and armed with two double rows of post-anal and a single median row of pre-anal teeth. The outer row of each of the former comprises about nine long and slender curved spines, and only just reaches to the anus, while the inner row, consisting of about thirteen short teeth, stretches just beyond the anus. The pre-anal teeth are about eight in number, the anterior being larger than the posterior members of the series. In connection with these pre-anal teeth it must be pointed out that Kurz in his original figure shows the anterior two broad and leaf-like (Fig 4 *a*), whereas in my specimens they were rather slender and gradually tapering to the tip. In one case, however, I did see a decided approach to the broad leaf-like form, and this, I think, precludes the idea, which might naturally arise, that Kurz's specimens and those found at the Botanic Gardens can be distinct varieties. The terminal claws are long and slender, with two small spines on the base of each. There are also three or four minute setæ on each side of the post-abdomen between the bases of the claws and the large post-anal spines. The maximum length of my specimens was $\frac{1}{35}$ in.

The foregoing account relates to the female only, no males having yet been recorded as far as I can ascertain.

Concerning the habits of this form and its appearance when living I have not much to say, as I only had a few living specimens under observation a very short time. My hope that some more would be forthcoming this year has been disappointed, for none have yet developed in the tank—at least, none were present so recently as the 26th of last month. It might possibly be imagined from the specific name that *I. agilis* is a very active creature, but

of course it is only relatively so. In common with all the species of the genus so far as known, it is a bottom-dwelling animal, and practically incapable of swimming. It can, however, as I had opportunity to observe, raise itself from the bottom and swim for short distances. This is a feat altogether beyond the powers of *I. sordidus*, except when very young, but Herrick says that his *I. spinifer* can also swim until "loaded up with old clothes and filth." As is very commonly the case with mud-loving Entomostraca, *I. agilis* is of a reddish colour, but the specimens I obtained were not so red as I usually find *I. sordidus*.

In conclusion, a few notes about the described species of *Ilyocryptus*, while not pretending to be sufficient in all cases for specific determination, will yet serve to indicate the relation of *I. agilis* to its allies.

I. sordidus, Liévin.—The first described and best-known form. Moult incomplete. Posterior marginal setæ with several accessory spines. Anus situated slightly posterior to middle of dorsal margin of post-abdomen. Median (pre-anal) row of post-abdominal teeth 10-14, subequal. Length $\frac{1}{40}''$-$\frac{1}{30}''$.

I. acutifrons, Sars.—Moult complete. Posterior marginal setæ with one accessory spine. Anus near claws, a character which separates this from all the other species. Median row of post-abdominal teeth, about six, the anterior two much enlarged. Length $\frac{1}{40}''$-$\frac{1}{30}''$.

I. agilis, Kurz.—Moult complete. Posterior marginal setæ with one accessory spine. Anus slightly anterior to middle of post-abdomen. Median post-abdominal teeth, about eight, increasing in size anteriorly. Length $\frac{1}{40}''$-$\frac{1}{33}''$.

The three foregoing species are European forms.

I. spinifer, Herrick.—Only recorded from the United States. Moult incomplete. Posterior marginal setæ with one accessory spine. First antennæ very long, rather more than eight times as long as broad. Anus slightly anterior to middle of post-abdomen. Median post-abdominal teeth, about ten. Outer row of elongated post-anal spines only four or five in number.

I. Halyi, Brady.—Described from specimens received from Ceylon. Moult incomplete. No definite statement made as to number of accessory spines on posterior marginal setæ. Anus slightly anterior to middle of post-abdomen. Median post-abdominal teeth, six or seven. Length $\frac{1}{26}''$.

I. longiremis, Sars.—Described from specimens raised from Australian dried mud. Moult incomplete. Posterior marginal setæ with one accessory spine. Anus slightly anterior to middle of post-abdomen. Median post-abdominal teeth, eight. Length reaching almost $\frac{1}{17}''$.

Explanation of Plate XXII.

Fig. 1. *Ilyocryptus agilis*, ♀, from the Victoria Regia Tank, Royal Botanic Gardens. × 85.

" 2. *Ilyocryptus agilis*. Shell-sculpture. × 200.

" 3. *Ilyocryptus agilis*. A single posterior marginal seta × 350.

" 4. *Ilyocryptus agilis*. Post-abdomen. × 130. *a*. One of the two anterior median teeth, as figured by Kurz.

On Cyrtonia tuba = Notommata tuba (Ehrenberg).

By Charles F. Rousselet, F.R.M.S.

(Read September 21st, 1894.)

Plate XX.

This Rotifer was included in Hudson and Gosse's Monograph as a British species on the strength of a sketch in Dr. Collins' Notebook, but whatever this figure (H. and G., Pl. XVII., Fig 8) may represent, it certainly is not Ehrenberg's *Notommata tuba.* This animal does not appear to have been seen again from the time Ehrenberg discovered two specimens in Berlin in June, 1832, until 1888, when Mr. G. Western found it at Staines, but just too late to be mentioned in the Supplement, which was then in the press. It has been obtained repeatedly since from the same locality, and I found it in June of last year at our Club excursion to Hertford Heath. Ehrenberg's description is extremely short and meagre, and his figure, although very imperfect, just enables one to recognize the creature. Under these circumstances, it seems desirable to place on record a more extended description and more correct figure of this very beautiful and interesting little Rotifer.

The head is the broadest part of the animal, and thence the body tapers down to the toes; it is, therefore, somewhat trumpet-shaped, and has from this appearance received its specific name. From a side view it is seen that the body has three distinct bends: the head is strongly curved ventralwards at the shoulder, giving the animal a humped appearance in this view; the lower part of the body is bent dorsalwards, and the two-jointed foot issues again at an angle towards the ventral side, and frequently the toes are also carried at an angle to the foot; the bends are quite constant and only the foot can be moved, but it is generally carried at an angle to the body, as drawn in the figure.

The corona (Fig. 2) is very large and unlike that of any other Rotifer in its shape and appearance; it consists of a broadly-oval trochal disc, fringed with long and fine cilia all round. Within this there are three ridges of longer and stouter cilia, or styles, one at each side and one in the middle near the ventral edge. The

movement of the large cilia on the ridges at the sides form quite a feature of the head, simulating auricles by their vigorous action. The trochal disc is highest and somewhat bent over on the dorsal side, and slightly concave in the centre. I could detect no sense organs on the disc, but a chain of ganglia seems to run all round below the surface of the corona, three of the ganglia being rather conspicuous near the dorsal edge. The secondary wreath surrounds the corona below the primary, and broadening on the ventral side, turns downwards almost at right angle to enclose a sub-square space, in the centre of which the densely-ciliated buccal orifice is situated. The exact arrangement will best be seen from the figure, if it be understood that the lower part of the drawing is in a plane at right angles to the corona. The buccal funnel leads to a heart-shaped mastax of moderate size, to which are attached two large pear-shaped glands (salivary glands ?). The trophi (Fig. 3) are of the submaleate type, with eight or nine teeth in each incus; in the figure of the jaws the unci and rami are, of course, not drawn in their natural position. The rami, as frequently occurs in Rotifers, are bent at right angles to the fulcrum, and it is, therefore, impossible to give a natural front view of all the parts on a flat piece of paper. In comparing figures of jaws of Rotifers with the structures themselves this must be borne in mind.

A slender œsophagus leads to a capacious thick-walled stomach, the cells of which are very large and nucleated; then follows the thin-walled and densely-ciliated intestine, which opens on the dorsal side just behind the foot. Large rounded gastric glands are attached to the upper part of the stomach as usual.

Below the centre of the trochal disc is situated the small brain carrying a small spherical crimson eye; two nerve threads run to the dorsal antenna, which is double and situated on a conical prominence below the head, and two further threads, one on each side, connect the lateral antennæ, situated low down on the sides of the body on little prominences, which become visible on a dorsal or ventral view. Lateral canals, with the usual glandular thickenings and vibratile tags, as well as an ample contractile vesicle, are also present. On the shoulder on each side there is a small granular mass or organ, apparently connected with the lateral canals, not usually found in Rotifers, the import of which is not quite clear, and similar masses are seen at the sides, near the middle of the body. The ovary is a single broad band on the

ventral side; the eggs are deposited and not carried about; spiny winter eggs have been observed, and I have lately seen the male (Fig. 4). It is a small, elongated, cone-shaped creature, with only a slight indication of being humped, and otherwise quite straight, having a simple ciliary wreath, a prominent red eye, dorsal and lateral antennæ, a contractile vesicle, and two small toes. The jaws and alimentary canal are quite absent, the elongated sperm sac filling the whole body cavity. The usual longitudinal muscular bands, which are striated, are present, and the circular bands are more apparent than is generally the case. The two small toes are conical and have the usual foot glands.

This is a very active and restless little Rotifer, constantly swimming about in the open water, except when it anchors itself to a thread and then spins round and round on its longer axis, like a synchæta. It is a summer form, appearing, as far as has been observed, from June to August only, and keeps very well in captivity for some weeks in a small bottle, and better than most Rotifers.

It is evident from the above description that this animal cannot remain in the genus Notommata, as now constituted; its affinities are with the Hydatinadæ, but it does not fit in any of the genera of this family, and, therefore, a new genus for its reception has to be created. I propose to call it *Cyrtonia tuba* (from κυρτών, a hunchback).

The generic and specific characters may be stated as follows:— Body conical, tapering from head to the toes, humped, with three distinct bends. Corona truncate, with three styligerous ridges. Ciliary wreaths encircling the corona, and a sub-square space at right angles to it on the ventral side; foot short, confluent, but forming a slight angle with the trunk; toes, two. Eye, single, cervical.

A mounted slide of this Rotifer will be deposited in the Cabinet of the Club to serve as type.

Size, $\frac{1}{100}$ to $\frac{1}{70}$in., of the male about $\frac{1}{250}$in. Found from June to August at Staines and Hertford Heath.

Explanation of Plate XX.

Fig. 1.—	*Cyrtonia tuba.*		Side view.
„ 2.—	„	„	Corona.
„ 3.—	„	„	Jaws.
„ 4.—	„	„	The male.

Further Notes on Macrotrachelous Callidinæ.

By David Bryce.

(*Read September 21st, 1894.*)

Plates XXIII. and XXIV.

This third paper on this group of Callidinæ has for its principal object the description of 10 species not referred to in my earlier notices.

Since I read to the Society the second of these, there has been added to the rapidly swelling list of Rotifer literature a very important contribution by Dr. Janson,[4] dealing exclusively with the Ehrenbergian family, Philodinæa, that is to say, with the genera included in Hudson and Gosse's sub-order Bdelloida. I do not propose here to fully enumerate the contents of this treatise, a copy of which the author very courteously presented to our library, and to which each of us has, therefore, convenient access, but merely to point out to our members, in general and appreciative terms, the scope and usefulness of the work, which is admirably planned, and presents to us in a very compact form a mass of information upon the genera included. It was high time that such a monograph should be put forward, more especially as regards the genera Callidina and Adineta, which have received so many additions in these recent years. In all 52 species are admitted as valid, of which Rotifer has 13 (including two species previously known under the generic name Actinurus), Philodina 8. Callidina 25, Discopus 1, and Adineta 5. In addition to the specific characters of each of these forms, Dr. Janson provides a general key for their identification, which will to some extent facilitate this puzzling task. There is also a bibliography in continuation of those published by Dr. Zelinka in 1886 and 1888, and carried up to September, 1892. My descriptions of *Call. pusilla*, *Call. cornigera*, and *Adineta clauda* were not put forward until after that date, and consequently these species are not among the 52 species admitted, and have to be added, as are

also the five new forms to be presently described, and one old form, not admitted by Janson, but for which I furnish a new description. It may be useful to note that among the forms rejected as not sufficiently described are two of the Callidinæ described by Gosse, viz., *bihamata* and *pigra*.

As to certain matters I have arrived at conclusions differing from those of Dr. Janson. Of these only one shall be here referred to, viz., the asserted presence of pellets of food in the stomachs of certain species of Callidinæ. He so distinctly implies a repeated error on my part with regard to these pellets that I am compelled to go into the question more fully than I had previously thought needful. In describing the stomach walls of a typical Philodine, he says (p. 9) :—" The lumen proper is enclosed in a strong cuticle, whose inner side is clothed with cilia; then follows the syncytial real wall, which absorbs the nutrient matter, and is usually coloured brownish or golden from fatty particles, has distributed in its substance numerous nuclei, and is surrounded externally by a thin membrane. A digestive function was until lately assigned to the pigment enclosed" (*i.e.*, to the coloured fatty particles), " Milne and Bryce regarded them as in many species portions of food, whilst Thompson [8] rightly recognized them as fat particles lying within the stomach wall." In another place (p. 66), referring to my description of *Call. lata*, he states that, according to me, "the fat particles of the stomach are particularly large and conspicuous."

Dr. Janson has misunderstood the statements made by Milne [5] and by myself if he thought that in our descriptions of food pellets *in* the stomach either of us referred to the well-known fatty particles enclosed in the stomach-wall itself. With *Call. constricta*, however, it is no difficult matter to demonstrate the presence of food pellets in the stomach. The œsophagus lies rather on the ventral side of the mastax, and the pellet-making is, therefore, best seen in ventral view, and to secure this a few of the Rotifers should be placed with a very little water on the cover of the live box. After a few minutes they will probably have taken hold of the glass, and have recommenced feeding. A very little carmine may then be placed on the opposite glass of the live box, and the body thereof gently adjusted to the cover. It will now be possible if the Rotifers continue feeding, as *constricta* probably will, to see the carmine particles pass down the long

gullet and between the rami into the œsophagus. It will be seen that there they are retained until a quantity has been collected, that then takes place a constriction of the œsophagus, commencing at the upper part, and that the contents are thereby forced downwards and into the stomach cavity, where they appear as a new pellet, while the œsophagus begins to collect fresh material. As soon as a pellet or two has been completed the making of more coloured pellets can be stopped by changing the water, after which the passage through the stomach of the coloured pellets already made can easily be watched.

It is scarcely necessary for me to add that I adhere to every point of my previous references to these pellet-making forms, including *Call. lata.*

I have now to explain sundry terms employed in my descriptions for the better distinction of the various divisions and parts of the body of a typical Callidina, terms which, however, apply equally well in most cases to the other Bdelloida. The term Body is used only to denote the entire animal, and includes, therefore, the three divisions—1. Head and neck; 2. Trunk; and 3. Foot. These in turn are composed of the so-called segments, the head and neck having six; the trunk six; and the foot (usually) four; in all 16.

The segments of the Head and Neck comprise the first and second Rostral, the Oral, the first, second, and third Cervical. The two rostral form the Rostrum (the anterior extremity of the body when extended), whose tip is partly invertile, and bears numerous tactile and motile cilia, shielded by the Rostral Lamellæ, two overlapping membranous plates, curiously arched. The non-invertile exterior of the tip is the Rostral Sheath. The second rostral is simply a broader base for the first.

Following them is the oral segment, distinguished by the presence of the mouth and of the ciliated discs, conspicuous even when infolded. When the mouth is opened, and the ciliated discs on their pedicels are pushed forth, these, together with the ciliated surfaces of the secondary wreath, are spoken of as the Corona. The unciliated surface now visible, in direct dorsal view, between the pedicels (and in some cases partly behind them), is the Upper Lip, which, widening as it recedes from the front, merges gradually at the sides into the Collar, that wider part immediately succeeding the bases of the pedicels. The Lower Lip is the ventral margin

of the mouth opening (now conspicuous on the ventral side of the corona). The first cervical segment carries the antenna, the second contains the greater part of the brain, and the third is usually occupied by the mastax. These six segments are retractile within those of the trunk.

The Trunk comprises those segments whose cuticle forms the exterior covering of the Callidina when most retracted. These are the first, second, third, and fourth Central, the Pre-anal, and the Anal. The second, third, and fourth central have the appearance of one large segment, the limits of the third being almost obliterated, and only indicated by slight undulations of the contour and of the longitudinal skinfolds. The greatest width of the body is usually attained in the third central, which, with the other central segments, affords room for the stomach and the two ovaries. A strong constriction separates the fourth central from the two following segments. The pre-anal is generally of considerable bulk; it contains the intestine, and gradually narrows into the smaller anal, which includes the contractile cloaca and the anus.

The Foot comprises normally four segments, the first, second, and third Joints, and the Terminal Joint, and is retractile within the trunk. The third joint bears the spurs, and is the last segment usually visible. In the act of taking fresh hold with the foot the terminal joint is quickly and momentarily protruded from the ventral portion of the third joint, and, being directed forwards and not backwards, escapes all but the keenest observation. It carries three or four toes, or in some species these are replaced by a perforate disc, used like them in the affixment of the foot.

Of these 16 segments it is often difficult to define the first rostral from the second, and the pre-anal from the anal. Frequently also the appearance of four cervical segments is equally confusing.

The food entering at the mouth is conducted by a long ciliated Gullet into the cavity of the mastax, and, passing between the rami, enters the Œsophagus, and is thence forced into the Stomach, whose length is slowly traversed. It is then projected into the Intestine, thence into the Contractile Cloaca (see under *Call. russeola*), and is finally expelled through the Anus.

The two ovaries are now demonstrated to consist each of two parts—a large Yolk-mass with eight (more or less) large bright nuclei, and a small Germ-mass placed upon the inner side of the Yolk-mass, and containing some 4 to 12 minute nuclei.

The body-length is measured from the tip of the rostrum to the tips of the spurs, when the Callidina is extended, as in crawling. The width of the corona is taken across the two discs, of the collar across the widest part immediately succeeding the bases of the pedicles, of the neck at the narrowest point between the collar and the first central, all in direct dorsal view, while the Callidina is feeding.

For greater accuracy and for convenience of comparison the dimensions are calculated and stated in microns (1000 microns= 1 mm.), and to avoid repetition of the symbol the figures are simply placed within brackets. Thus (262) is to be understood as 262 microns=·262 mm. The small numbers following authors' names refer to appended list of authorities.

All the 10 species now to be described belong to that numerous group which I have distinguished by the term Macrotrachelous, as indicating their common characteristic of a relatively short foot. The first five species have not, I believe, been hitherto recorded for the United Kingdom, and inasmuch as there does not exist, as far as I can learn, any description in our language of any one of them, I have thought it desirable to reproduce more or less closely the original descriptions of the respective writers. The remaining five species are new to science.

Callidina tetraodon, Ehr.

Sp. Ch. — Body yellowish-white, only moderately transparent. Rostral lamellæ somewhat laterally projecting ; spurs (11 to 15) slightly longer than width of segment carrying them, and seated upon cushion-like swellings. Rami (30 to 32), formula $\frac{4}{4}$. Maximum length (620).

Janson [4] gives these characters for a form assigned by him to the above species, which was defined by Ehrenberg [1] in 1848 with the very scanty description of :—Body hyaline, eggs white, four larger teeth central on each ramus, length $\frac{1}{3}$ line.

The following supplementary details are added by Janson :— Body of 15 segments, with, dorsally and ventrally, eight longitudinal skinfolds. Hypodermis stout, milky white, slightly opaque ; alimentary tract usually pale yellow. Foot very short, of three segments in all. The corona, seldom to be seen unfolded, is moderately large, and only a little exceeds the neck in width. Upper lip notched. Head, with two fronto-lateral prominences, as

in *Call. longirostris*, but less developed. The rami have very strong comb-like outer margins, usually of a dark golden or brown colour, and a fifth tooth is sometimes faintly indicated. Median ventral salivary gland conspicuously large. Yolk-mass with 8 to 12 nuclei, the germ-mass with 11 minute nuclei. Four massive foot-glands, built up of very large cells, extend, alongside the intestine, far into the body cavity. They unite and send many fine strands to the disc terminating the last tube-like foot segment. This disc, apparently formed from two toes (and having in direct view the outline of an oval pinched in laterally), has eight perforations, through which discharge the canaliculi proceeding from the foot-glands, and an extremely delicate flickering (as of cilia) was noticed at the extreme end of the disc. Antenna short and two-jointed. The excretory system has six vibratile tags (on each side). The brain is posteriorly three-lobed. Janson further describes (what he regards as) the winter or resting-egg of this species as having its surface covered with short, sharp spines, whose points are directed towards the two poles of the egg.

A form which I have found in moss from widely separated localities is, I have little doubt, that described by Janson. The most important difference is the structure of the upper lip, a character which Janson does not appear to value so highly as I do. In my examples the two lobes of the upper lip were rather prominent, and were separated by a conspicuous U-shaped sulcus, whereas he has drawn them as almost contiguous, divided only by a narrow notch. None which I have yet measured have exceeded in length 443 microns. In one measuring (427) when extended the extreme length of the corona when feeding was (87), of the collar (67), while the narrowest neck dimension was (48). This proportion of corona to neck is at first sight widely different from that indicated by Janson, but it is probable that his comparison is based upon the greatest width of the neck. In my view this latter method of comparison is rather unreliable, though certainly preferable to a comparison of the corona with the body-width, which Janson very properly condemns as fallacious. I prefer to compare, firstly, the corona-width with the collar-width and the narrowest neck-width; and, secondly, the corona-width with the length of the individual specimen, when extended as in crawling.

The species is easily distinguished from all other Callidinæ by the peculiar swollen bases or cushions upon which are seated the

moderately-curved and tapering spurs. Besides this mark are equally distinctive the prominent lobes of the upper lip, and the tooth formula, while the modification of the toes into a tube-like process, ending in a perforated disc, occurs only in a few other forms. It is probably of very general distribution in this country, as I have already seen examples from Devon, Bucks, Essex, and Sussex. I have observed in some specimens that the body fluid contained numbers of minute granular bodies which flowed hither and thither with each movement of the skin or organs. Dr. Zelinka[8] has already observed similar constituents of the body fluid in *Call. russeola*, and says that they are doubtless the same structures which Leydig in his time described as blood-corpuscles, and which we likewise have to regard as such.

Callidina alpium, Ehr.[2] (Pl. XXIII., Fig. 1.)

Sp. Ch.—Stout, transparent; skin rough and stippled, but not viscid; 14 dorsal and lateral longitudinal, and 9-10 ventral transverse skin-folds; anterior margin of first central segment, with six knob-like prominences in two series, which produce a cleft appearance at anterior end when body contracted. Head with fronto-lateral swellings; corona (54), sulcus (16) wide by (10) deep; upper lip concave, (usually) with minute tooth-like prominences. Mastax longer than broad, rami ($28\frac{1}{2}$), formula $\frac{2}{2}$, teeth slightly diverging towards inner edge of ramus. Foot moderately short, of four joints; spurs (4-5), short blunt cones, with moderate interstice; toes four, in two dissimilar pairs. Max. length (238).

Habitat: Wall and ground moss, Bognor; roof moss, very abundant, Deal.

On page 11 of the "Supplement" Dr. Hudson,[3] referring to Ehrenberg's species (under the name "alpina"), states that it is an alpine species of which he could find no details. Thanks, however, to the comprehensive Bibliography furnished by Zelinka, I have been able to find the original description, a very brief one, which I quote:—"Corpore hyalino, in contractione dorso longitudinaliter, ventre transverse plicato, ovulis albis, dentibus binis eccentricis. Longit. $\frac{1}{3}'''$. *E. montis Rosæ alpium*, 11138 pedum altitudine. Plicæ longitudinales 14, transversæ 9-10 valde singulares." This description was published in 1853, and the species was thereafter, like most of the other Ehrenbergian Cal-

lidinæ, lost sight of until recent years. In 1891 Zelinka [9] mentions that he had met with it, and remarks that it is not exclusively alpine. More lately Janson [4] (p. 29), commenting upon the insufficiency of Ehrenberg's descriptions of Callidinæ, quotes that of *C. alpium*, and declares that "if we omit the 'ventre transverse plicato,' which apparently is in this sense incorrect, and occurs in no Callidina, this description fits all the hitherto described Callidinæ with two teeth, and these are nine in number. "It is clear," he proceeds, "that a description thus common is worth none at all. *Call. alpium* has, therefore, been found by no later observer, and since Ehrenberg not again described." Janson has obviously overlooked Zelinka's identification of the species, but apart from this, he is mistaken in assuming that the character of ventral transverse folds, so emphasized by Ehrenberg, is incorrect. I have found it in two species, one of which, however, differs from the other characters given by Ehrenberg in having a tooth formula $\frac{5}{6}$, and in not being transparent. The other form, however, is fairly so, and has the tooth formula $\frac{2}{2}$. In it the transverse ventral folds are conspicuous both when the animal is contracted and when it is extended. I have, therefore, little hesitation in assigning this form to Ehrenberg's species, and in this case I substitute for the original specific diagnosis one based upon the specimens I have myself examined, with the fuller details required by the greater knowledge of to-day.

In only one particular is there, I think, a discrepancy. My examples were barely $\frac{1}{100}$ inch, or one-third the length given by Ehrenberg. Inasmuch, however, as all the eight species of Callidina described by him were either $\frac{1}{2}$ or $\frac{1}{3}$ line, it is suggested that he employed at the time no very exact means of measurement, and therefore I attach little importance to the point. The species is of robust habit, slow and deliberate in its movements. The ample discs are separated by a wide sulcus. In direct dorsal view, the upper lip is somewhat concave, without lobes or hillocks, but the edge is usually finely toothed centrally, more coarsely laterally, the teeth appearing to be simply of fleshy character. While feeding the neck is unusually shortened by partial retraction. The skin, always clean, is rough, finely stippled, and rather stiff. A peculiar conformation of the anterior margin of that portion covering the first central segment is very distinctive. When the creature is extended or feeding this margin is seen to

bear four dorsal and two ventral knob-like prominences arranged in two sets of three. On the ventral side the pair there visible are widely separated, the intervening margin of the segment being excised in a moderate curve. When the Callidina is feeding the neck is so withdrawn by retraction that the exterior of the under-lip rests upon this excised margin. On the dorsal side the interval between the second and third prominence is greater than that between the first and second or the third and fourth. When the animal contracts itself, and the invertile segments are drawn back within the trunk segments in the usual way, these six prominences become the anterior of the irregularly globose figure which results, and in the process each set of three is so gathered together, while remaining relatively apart from the other set, that the produced anterior extremity of the contracted animal seems to have a median cleft, an appearance I have not observed in any other species.

The transverse skin-folds do not extend quite across the ventral surface. When this is directly visible there are conspicuous at each side two longitudinal folds, properly belonging to the lateral series, and more centrally three very short folds. The central one extends only from near the edge of the first central segment where most excised to the posterior of the same segment, but not reaching the first transverse fold. The pair next to it are but little longer. Starting near the tips of the ventral prominences already mentioned, they extend to the first transverse fold. These three short skin-folds are not included in the stated fourteen dorsal and lateral folds. The next pair are much longer, and proceed from the tips of the prominences to near the rear of the fourth trunk segment, describing each a curve in their course (like the brackets of a parenthesis). The third pair arise from between the ventral prominences and the outer dorsal prominences, and proceed to the rear of the pre-anal segment. In like manner the transverse folds have various lengths and courses. The first and second belong to the second central, the next three to the third, and the following three to the fourth. None of these eight mark the limits of segments, but the ninth and a faintly-marked tenth are plainly the posterior edges of the fourth central and the pre-anal segment. Of the first eight only Nos. 4, 5, and 6 reach the inner longer pair of longitudinal folds. Nos. 7 and 8 turn towards each other, and become continuous. It is usual to refer to that part of the foot which is protruded beyond the spur-bearing segment as consisting of a

single joint. Having regard, however, to the separate movements of the toes and their presumable control by different muscles, I incline to consider that in reality there are two segments present, at all events in those cases where there are either three or four toes. The central single toe (or where there are four the central pair) is protruded and withdrawn independently of the outer pair, and usually distinctly beyond them. The central toe (or pair) is probably, therefore, to be more correctly considered as proceeding from the real terminal, the outer pair of toes from the penultimate, and the spurs from the ante-penultimate foot joint. In the present case the central pair of toes are stouter than the outer pair, and broadly truncate.

Callidina russeola, Zelinka.[9]

Sp. Ch.—Large and bulky. Body stout throughout, not centrally swollen, but somewhat thickened at level of mastax and at pre-anal segment. Yellowish-red to reddish. Corona large, upper lip wide, with slightly convex margin, without lobes or hillocks. Rostral lamellæ stand apart to right and left of rostrum tip. Skin stippled. Antenna short. Mastax with six salivary glands attached. Rami longer than combined width, (31) against (29·4), formula $\frac{5}{5}$ to $\frac{7}{7}$. Vascular canals with eight vibratile tags on each side. Mucus glands of foot built up each of three series of cells. Foot short, of three joints in all, the second bearing the spurs, and the terminal furnished with a perforate disc, of reniform outline on which arise two small prominences. Spurs short (12), perforate at tips, and separated by wide (13), slightly convex interstice. Maximum length (" 500 " Zelinka, " 680 " Janson).

In 1892 I found near Felixstowe a large Callidina, which I was unable to identify then, but which I am now certain was this species, which had been described in the previous year by Zelinka, who has devoted much time to a searching investigation of every detail of its anatomy and of its embryological development. The most distinctive points in its diagnosis are the form of the upper lip, and the suppression or absence of the toes, these being represented only by the two small prominences on the disc of the terminal joint. In the rami is found a good instance of the variation of the tooth-formula which obtains in many species. The fine striæ which, as usual, cover the

upper surface of the rami, before and behind the ridges known as "teeth," are present also between these.

Whilst conducting his investigations Zelinka kept specimens of this species, and of some other forms, alive in water, in shallow glass vessels, well covered, and provided with algæ, from the beginning of February to the beginning of July, the vessels being daily looked over, all eggs removed, and the number of specimens ascertained, so that young individuals could not unnoticed remain in the vessels. Thus he proved that the one generation of Callidinæ lived for five months, at the end of which period the observations were given over. Such a period of active life, unbroken by any interval of inactivity enforced from lack of water, is, as he remarks, "a much longer span of life than has hitherto been imagined to be possible for these animals."

He was also able to satisfy himself that Plate's [6], [7] statements as to the discharge of the vascular canals into the cloaca itself in the cases of *Rotifer vulgaris* and *Call. magna* applied also to *Call. russeola*. The two canals unite into a single duct, which opens into the cloaca at the boundary between it and the intestine. There is no separate contractile vesicle such as is found in all other Rotifera, except the Bdelloida, and such as, until these most recent observations, has been assumed to be possessed also by them. The cloaca itself is distensible and contractile, and fulfils the double function of contractile vesicle and cloaca. This new view is strongly supported by Janson,[4] who regards the contractile cloaca of the Bdelloida as additional evidence that this group is the primitive group of the Rotifera.

Callidina vorax, Janson.[4]

Sp. Ch.—Body usually very reddish. Corona very ample and flat. Rostral lamellæ somewhat laterally projecting. Spurs $\frac{1}{3}$ width of segment (16·5), with very wide interstice and perforate; four toes; four mucus glands. Rami (23·4-24), with formula $\frac{2}{2}$. Maximum length (440).

A large form somewhat resembling *Call. russeola* in build, but easily distinguished by the form of the corona, the tooth-formula, the foot structure, and the very wide interstice between the spurs. The body is described as consisting of 16 segments, of which seven belong to the head and neck, six to the trunk, and three (in all) to the foot. Thus the head and neck have one more

segment than usual, and the foot one less. The spurs arise at a distance from each other of almost twice their length, and the segment bearing them has dorsally a transverse skin fold, which hides about a third of their length, so that they appear to be only (11) long. They are perforate, and can be moved towards each other like forceps. The four toes of the foot are all short, but the central pair are smaller than the outer. There are four mucus glands, which unite and give off six ducts leading to openings in the two spurs and the four toes. Of vibratile tags six were found on each side. The yolk-mass of the ovary contains eight large round nuclei, and the germ-mass usually four minute nuclei. The short antenna is two-jointed.

I have little to add to these particulars. In one example the corona measured (102), the collar (71), the neck (55). The eggs which, laid by isolated specimens, I could identify as belonging to this species were broadly oval, about (80) long by (63) broad, the surface having slight prominences, and the smaller end being bluntly pointed. The whole egg was of a bright chitinous brown. The embryo was fully developed in about seven days. I have met with the species in wall moss from Clapton and from Bognor, and in ground moss from Arundel.

Callidina Ehrenbergii, Janson.[4]

Sp. Ch.—Body colourless or reddish, with slight thickening below mastax. Rostrum broadly truncate, the sheath drawn out into lateral auricles. Spurs as long (8-10) as width of their segment, with small interstice. Rami (20-22), formula, $\frac{2}{2}$. Maximum length (360).

The body is stated to consist of 11 segments, of which four belong to the head and neck, four to the trunk, and three to the foot. The chief mark of the species is the structure of the rostrum, which is quite similar to that of the Adinetæ. At its anterior end the rostral sheath is dorsally bent broadly downwards, and thus, in lateral view, forms a little "hook." The ventral surface of this sheath is very deeply excavate; there only project two corners towards the centre and form with the dorsal arch a pair of lateral auricles. In this sheath thus modified are placed the two small rostral lamellæ, from whose lower surfaces arise the cilia. Frequently several long stiff cilia protrude from the auricles, but from their extreme delicacy are difficult to

define. The corona, very rarely displayed, is exactly equal in width to the neck. When the wheels are at work the rostrum remains extended. There are eight dorsal, but only four ventral skin-folds. The spurs of the very short foot are usually spread out in swallowtail fashion, and are not perforate, nor are they quite constant in shape in different individuals. Each of the three short toes has three perforations for the emission of mucus. Both the yolk-mass and the germ-mass have eight nuclei. The outer margins of the rami are thickened and dark yellow, and have a comb-like edge. The supposed resting egg is described and figured as having a few simple low prominences.

The species is said to be a true moss form, which was only rarely found in open water; its movements are extremely lively and quick. It is with just a little doubt that I assign to it a form of rather frequent occurrence in "dry" moss. The doubt arises partly from my inability to make out so clearly as I could wish the described structure of the rostrum, and partly from the form of the eggs laid by isolated examples. These eggs were covered with blunt spines, and were not resting eggs, but hatched out without any long delay, the embryo moving within 12 days of isolation of parents. In other respects the description fitted fairly well, both as to structure and habits. I thought the upper lip, not mentioned by Janson, was rather distinctive. It is simple in outline, and rises nearly to level of discs, completely hiding the moderate gap between pedicels. The collar width was slightly less than that of the corona.

Callidina fusca, n. sp. (Pl. XXIII., Fig. 2.)

Sp. Ch.—Rather small, but stout. Skin of trunk greyish or reddish-brown, rough and viscid, with coarse, irregular dorsal and lateral longitudinal, and obscure transverse ventral folds; of extremities colourless, clean and fairly smooth. First cervical with three prominent swellings, two lateral, one sub-ventral. Corona (32), just wider than collar, ($28\frac{1}{2}$); sulcus narrow; upper lip, a prominent, undivided lobe. Mastax scutelliform, rami (15), formula, $\frac{5}{5}$ to $\frac{5}{6}$. Foot of four joints, the first with distinct boss. Spurs moderately short (7) and acute. Toes, three. Food moulded into pellets. Maximum length (211).

A robust little form, whose colour, shoulder swellings, pro-

minent rostrum, and coat of dirt recall the like points of *Call. longirostris*, with a suggestion of *Call. aspera*, which in size it more nearly resembles. The skin-folds are not, however, wart-crowned, but have their ridges broken by numerous transverse creases. That the skin is viscid is proved by the coating of foreign matter with which it is liberally covered, but the viscidity is confined to the trunk. The head, neck, and foot are usually clean. Save on the first foot joint, I could see no trace of the minute pores which, according to Janson,[4] pour forth the viscid secretion in other species. The transverse ventral folds are much less distinct than in *Call. alpium*, but still sufficiently obvious. The corona is rather small, and the discs approach each other very nearly, and have in dorsal view a somewhat square outline.

The first cervical segment has three almost lappet-like swellings of the hypodermic layer, of which two proceed from the base of the antennæ towards the ventral side, attaining greatest size on the dorso-lateral angle, and thus forming thickened and somewhat prominent epaulets, and the third lies across the ventral surface just below the mouth. When the corona is displayed, the sub-ventral process is thrown outwards and backwards, and is distinct, either in direct ventral or in lateral view. The lateral lobes correspond to the fronto-lateral prominences of *Call. longirostris* and some other forms, but I know of no other species having the sub-ventral swelling. I have thought that the function of all three is to protect the more delicate parts of the head when the creature is pushing its way among the sand-grains, which coat even the cleanest specimens of ground and wall moss, and I should accordingly expect that all or most other species with these swellings would be found principally among such mosses. It might be further inferred that the species which have developed these protective swellings are species of longer standing in their chosen habitat than others which have not yet acquired them.

The antenna is rather short, but is stout and tipped with rather long setæ. The foot boss is more prominent and harder-looking than usual, while across the anal segment there is a distinct dorsal ridge, which appears to mark the limit of the non-invertile skin. Specimens were exhibited at the meeting of the Club on 6th October, 1893.

Habitat. Wall moss from South Bersted, near Bognor.

Callidina plena, n. sp. (Pl. XXIV., Fig. 4.)

Sp. Ch.—Moderately large and robust. Skin smooth, dorsal folds faint, lateral strong. Corona very wide (73), one-half wider than collar (50); upper lip with two low conical lobes, separated by shallow, broadly V-like groove. Rami (19), with thin wing-like outer expansion of rounded outline, giving total breadth (25), the rami proper totalling about (17); formula $2+^1$, $^1+2$. Foot with four joints, in length about (40), or one-eighth of whole; spurs short cones (6) with narrow interstice; toes four. Stomach wall lined with cilia, driving the food in a spiral course. Maximum length (380), average (340).

When crawling about this species resembles very much *Call. musculosa*, but when it pushes forth its corona and begins to feed it assumes somewhat of the compact and apparently stout form of *Call. quadricornifera*. Like that commoner form, however, it is then much flattened, and the apparent bulk is deceptive. It is readily distinguished by the great width of the corona as compared with the collar and with the body length, a strong character well supported by the modelling of the upper lip, the feeding position, the small spurs, and the four toes. The planes of the two discs do not coincide, but incline somewhat obviously to the median line. The upper lip is so prominent that the conical lobes attain the level of the discs at their inner side. Thus the whole breadth is approximately flat.

The three cervical segments are all short, especially the first and second, whilst the second, third, and fourth central are rather longer than usual. In the feeding position the whole of the second cervical and part of the first is hidden within the third, and of the foot only the spurs and part of the first joint are visible. The first foot joint is of fair length, but the second is short, and the third almost indistinguishable. The four toes are, as usual, in two pairs, of which the outer pair are larger than the inner. One tooth on each ramus is exceedingly faint.

I have found this species in great numbers in wall moss from Aldwick, near Bognor, and I was able also to identify certain eggs as pertaining to it. These were not truly oval, but a little flattened, and the surface bore many low rounded prominences, of which I counted 14 to 18 around the peripheral outline. As they lay on their sides these eggs measured (76 to 85) longest by (50 to 54) shortest diameter, and I estimated their thickness at about

(38). In one case the embryo hatched out in about seven days. In a crushed specimen I was able to count twelve minute nuclei in the germ-mass.

Callidina habita, n. sp. (Pl. XXIV., Fig. 5.)

Sp. Ch.—Moderately large and stout. Skin smooth, very finely stippled, with faint dorsal and strong lateral folds. Corona rather wide (64), about one-fourth wider than collar (51); upper lip rather prominent, with two lobes separated by narrow notch. Rami (24), with thin wing-like outer extension, of rounded outline; formula $2+^1, ^1+2$. Foot of three joints, short, stout; spurs very short, with very broad bases; toes three, very short. Maximum length (570), average (400).

In company with *C. plena* were a few specimens of this form, which presented an almost similar appearance when travelling about, but always distinguishable by the spurs and by a greater stoutness of the body, especially in the pre-anal and anal segments and the foot. Yet when displayed the corona was found to be decidedly narrower, the difference arising partly from a lesser distance between the discs. The rami having the same formula were decidedly longer, and the wing-like margin was narrower. I could not detect more than three toes on the terminal foot joint, one being (if fully protruded) very thick and abruptly truncate. The first foot joint bears a small but distinct dorsal boss, and the next joint, which carries the spurs, has a stout fold of skin projecting over them. The spurs are extremely short cones with unusually broad and thick bases; the points suddenly attenuate and a little produced. As in *C. plena* the outer edge is nearly straight, but the inner edges, nearly in contact at the base, are first boldly convex and then apparently slightly concave near the tip. Their extremities stand apart about (22 to 24), the corresponding figure in *plena* being (15 to 17).

I have also found the species in moss from a thatched roof at Deal, and in ground moss from just above tide mark at Bognor.

Callidina angusta, n. sp. (Pl. XXIV., Fig. 6.)

Sp. Ch.—Of moderate size and rather slender; corona narrow (29), about equal to collar, but apparently less. The lateral margins of the mouth have externally a prominent, almost pointed, swelling. The discs, rather square in outline, are separated by a

narrow cleft. Antenna short. Rami, formula $\frac{2}{2}$. Length when feeding (275).

My particulars of this species, of which I found a single example on two different occasions in ground moss collected near Bognor, are less complete than I could have wished. When feeding it extends itself to its utmost (a rather unusual habit among Callidinæ), displaying a slender head, neck, and trunk, and a rather short foot, with stout but short spurs. At the collar level, but really arising from the lateral margins of the mouth, there is on each side a rather prominent and almost pointed swelling, best seen in ventral aspect, and giving, at first glance, the appearance of a wider collar than is actually present. That the mouth border should be thickened at the sides is usual among the Philodinadæ, but it is unusual that this thickening should result in or be supplemented by external and prominent swellings. This curious character is also present in the species next to be described, but in that case it can scarcely be seen except when looking directly upon the mouth from above.

The outstretched attitude, the generally slender body, the peculiarities of the corona and of the mouth border sufficiently, at all events as yet, distinguish the species, which seems uncommon.

Callidina eremita, n. sp. (Pl. XXIII., Fig. 3.)

Sp. Ch.—Small, with slender head and neck, and swollen central trunk. Skin smooth, with strong lateral folds. Corona, moderately spreading, (38); discs on high diverging pedicels, separated by a deep U-shaped sulcus, in which is conspicuous a small setiform fleshy tooth, (5) long and (1) diam. Upper lip remote from pedicels, of simple, bold, curved outline, lateral mouth margins externally swollen. Collar (28); neck (25), of long narrow segments, and with a distinct annular thickening at level of antenna. Mastax rather scutelliform; rami (17); formula, $\frac{3}{3}$ to $\frac{3}{4}$. Foot extremely short, only visible when animal dislodged and crawling. Spurs, very minute cones or absent. Food moulded into pellets. Secretes a flask-shaped case, at first colourless, but gradually becoming brown.

An extremely interesting species, with many distinctive marks. In preceding papers I have recorded the tube-dwelling habits of *Call. elegans*, Milne, and *Call. pusilla*. In both instances the tubes appeared externally to be a more or less rough

agglomeration of drift particles, in which one failed to detect the presence of any secretion from the tenant. The tube made by *Call. eremita* is undeniably mainly composed of a secretion, for if forced by circumstances to abandon its tube or case the Callidina will, in the live box and in the course of a few days, develop around it a delicate investment, which is gradually increased in density until it is recognizable as a perfect case. The form is that of a somewhat flattened flask, which is attached to the moss leaf or stem by that side which protects the ventrum. The neck of the flask fits somewhat tightly to the first central when the animal is extended or feeding, and is there somewhat viscid, as is evidenced by a cloud-like mass of drift particles adhering to it. It also adheres to the skin, so that when the animal withdraws from view the anterior edges of the case are drawn inwards and the opening closed. The case is usually only just large enough to contain the Rotifer when retracted; sometimes, however, an egg could also be seen in the cavity. I could detect no trace of structure, but noticed only a somewhat plentiful sprinkling of minute and more solid-looking points. I conjecture, however, that the material employed would probably be identical with that employed by the Callidinæ generally for the "varnishing" of their trunks when they fear deprivation of water. I believe, too, that it is mainly secreted while the animal is retracted, a position which my specimens would retain frequently for hours. When desired it was usually easy, however, to induce them to display their wheels; the introduction into the live box of a drop of clear cold water was very effective. Then instinct prevailed over modesty, and out would come the Callidina to sample the current food supply. The head and neck once protruded, usually at right angles to the trunk, the discs were promptly displayed and the cilia vigorously exerted. The high diverging pedicels give a very distinctive character to the corona, and equally striking is the bold curvature of the upper lip, which is apparently nowhere in contact with the pedicels, but stands back so that their common fleshy base is visible. Centrally between the pedicels stands a short setiform fleshy tooth. Thus outstretched the head and neck are nearly as long as the trunk, and the bizarre appearance of the swollen central trunk is increased by the first central segment which occupies the neck of the flask being slender like the head and neck. The mastax is of good size. Besides the three

well-marked teeth on each ramus (slightly diverging towards the inner edge), a faint fourth could sometimes be detected. The lateral skin-folds were rather conspicuous on the trunk. The rostrum is stout but very short.

It was difficult to make out anything about the internal organs, but in many instances the stomach contained pellets of food. A young specimen seen crawling about was in build rather like others of the small and slender species, but older individuals are very loth to move about, and the trunk becomes swollen, and the foot almost permanently hidden. I thought, in dislodged examples, that I could distinguish two very minute peg-like spurs placed far apart at the lateral angles of a stout joint, but I failed, after repeated efforts, to force their display, far less that of the toes.

It seems obvious that this Callidina has acquired its long neck, its swollen trunk, and its short and constantly hidden foot after becoming a tube-dweller. In these points of habit and of build it recalls *Call. reclusa*, which dwells in the cortical cells of the branches of Sphagnum, and which has to push its head and neck through a small natural opening in the cell wall.

The species was found in wall mosses from various localities near Bognor, but from its retiring habits is not easy to detect.

Reference is made by small numbers after names of authors to the following works :—

1. *Ehrenberg.*—Fortgesetzte Beobachtungen über atmosphärische mikroskopische Organismen. Novarum specierum diagnosis. Monatsberichte der Berliner Akad. der Wiss., p. 380, 1848.

2. *Ehrenberg.*—Über neue Anschauungen des Kleinsten nördlichen Polarlebens. Monatsberichte der Berl. Akad. der Wiss., p. 529, 1853.

3. *C. T. Hudson* and *P. H. Gosse.*—The Rotifera or Wheel-animalcules, London, 1886, and Supplement, 1889.

4. *O. Janson.*—Versuch einer Übersicht über die Rotatorien-Familie der Philodinæen. Beilage zum xii. Bande der Abhandl. des Naturw. Vereins zu Bremen, 1893.

5. *W. Milne.*—On the defectiveness of the Eyespot as a means of Generic Distinction in the Philodinæa. Proc. Phil. Soc., Glasgow, 1886.

6. *L. Plate.*—Beiträge zur Naturgeschichte der Rotatorien. Jen. Zeitschr. für Naturwiss., Vol. xix., Part i., 1885.

7. *L. Plate.*—Über die Rotatorienfauna des Bottnischen Meerbusens. Zeitsch. für Wiss. Zool., Vol. xlix., 1889.

8. *P. G. Thompson.*—Moss-haunting Rotifers. Science Gossip, Vol. xxviii., p. 56, 1892.

9. *Carl Zelinka.*—Studien über Raderthiere, iii., Zur Entwickelungsgeschichte der Räderthiere nebst Bemerkungen über ihre Anatomie und Biologie. Zeits. für Wiss. Zool., Vol. liii., 1891.

Explanation of Plates.

Plate XXIII.

Fig. 1. *Callidina alpium*, dorsal. × 480.
„ 2. *Callidina fusca*, ventral. × 480.
2*a*. Head and neck, lateral.
2*b*. Foot, dorsal.
2*c*. Foot, lateral.
2*d*. Mastax. × 800.
„ 3. *Callidina eremita*, dorsal. × 640.
3*a*. Rami under pressure, the normally inrolled edges forced back. × 800.

Plate XXIV.

Fig. 4. *Callidina plena*, dorsal. × 400.
4*a*. Rostrum and head extended, ventral. × 800.
„ 5. *Callidina habita*, dorsal. × 400.
5*a*. Rami under pressure, the normally inrolled edges forced back. × 800.
„ 6. *Callidina angusta*, ventral. × 480.

A Note on the Determination of the Foci of Microscope Objectives and Screen Distances by Simple Arithmetic.

By Edward M. Nelson, F.R.M.S.

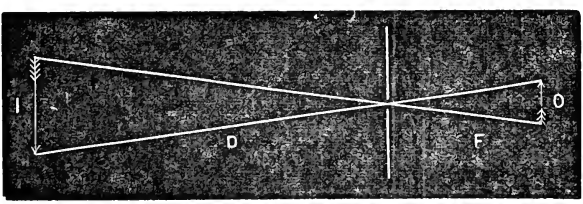
(*Read March 16th, 1894.*)

From time to time various articles have appeared in text-books and in periodicals with regard to the determination both of the foci of microscope objectives, lantern and camera lenses, as well as of the distance a screen should be placed from a lantern to obtain, with a projection lens of a given focus, a disc of a given size.

As both these questions are involved in the same discussion, they may be taken together. The usual argument, found in text-books and periodicals treating of the lantern and camera, can hardly be called an optical one, for it merely consists of the solution of an elementary geometrical problem, involving a rule-of-three sum, but which, at the same time, wholly ignores the first principles of optics. The formula in question is found under many forms, the following is an example :—

$$\text{Distance} = \frac{\text{disc} \times \text{focus}}{\text{mask}} \quad \text{(i.)}$$

We will first examine the method by which this formula is obtained. It might aptly be termed the pinhole method, for it consists in drawing two lines across one another, as in the Fig., which is neither more nor less than an illustration of a pinhole camera.



Instead of adhering to the usual nomenclature, it will be preferable to call the disc the image (i), and the mask the object (o),

d being the distance between the image and the lens, and f the focus; no confusion can then possibly arise between d for distance and d for disc.

In the figure we see that we have two similar triangles, consequently—

$$\frac{i}{d} = \frac{o}{f} \text{ and } d = \frac{if}{o}.$$

This, then, is the method by which formula (i.) is obtained. The fallacy underlying this argument is that a pinhole has no focus. You are therefore introducing a term into your formula which has no existence in fact; or, to look at the question from another point of view, the distance between the lens and the object (slide) in an ordinary lantern is not the equivalent focal length of the projection lens. The object can only be at the principal focal point of the lens when the image (disc) is at an infinite distance from the lens, and consequently of infinite size. An excellent illustration of this error may be seen in the following example:—It is required to project a disc of 3 inches with a projection lens of 6 inches focus, the mask being 3 inches. Here we have a projection of the same size, and everyone who has had the smallest experience with optical instruments knows that both the object and the image will have to be at a distance from the lens equal to twice its focal length; but what says the pinhole formula (i.)?

$$d = \frac{3 \times 6}{3} = 6 \text{ inches} = \text{focus}.$$

This is perfectly true in the case of a pinhole, as it is of no consequence what the distance may be, provided that the object is placed at a similar distance on the other side; but, with regard to a lens, it is quite erroneous, because the distance must be twice the focus, or twelve inches. The practice often adopted in elementary text-books of explaining the action of lenses by the illustration of a pinhole is to be regretted. It is not true that a lens is merely a pinhole of enlarged aperture, as is so often stated; a radical difference exists between them, viz., that a lens has two principal focal points, while a pinhole has none.

Hence, this common formula (i.) is inexact; nevertheless, it may be said that it never was intended to be absolutely accurate, but that it has been generally adopted on the ground of its sim-

plicity. On this point we can join issue, by showing that it is not so simple as the more accurate optical formula. The expression "more accurate" is used, because, to determine the quantities in question with absolute accuracy, when a projection lens, consisting of two or more elements, is employed, would, notwithstanding the simplicity of the computation, necessitate the knowledge of the curvatures of each lens, as well as of the refractive indices of the various glasses of which they are composed, data which are not commonly available.

The optical formula, which may be found in every book on natural physics, and in the first page of every optical text-book, is

$$\frac{1}{f} = \frac{1}{d} + \frac{1}{p} \ldots\ldots\ldots\ldots\ldots\ldots \text{(ii.)}$$

where d is the distance of the image from the first Gauss point, and p that from the second Gauss point to the object.

Now, for the reasons stated above, the position of the Gauss points* from which d and p are measured is usually unknown; but, as d is large compared with p, the percentage of error in the case of each measurement is by no means the same; thus, an error of one inch in six or nine inches is a very different matter to that of one inch in twenty feet. If, for example, there is an error, k, of one inch in the measurement of the p side, and if $m = 60$, the error on the d side would be mk or five feet; while the same error of one inch on the d side would only amount to $\frac{k}{m}$ or $\frac{1}{60}$ inch on the p side.

It is clear, therefore, that we must somehow or other get rid of p, while the small error in the measurement of d may be allowed to stand. Fortunately, there is another quantity which can be measured with absolute accuracy, and that is the magnifying power, m, or the number of times the image is larger than the object; this is expressed by the fraction $\frac{i}{o} = m$. (Of course, in the case of a camera lens, the object and image are transposed, so that in this and all subsequent formulæ, when only a camera lens is in question, i will mean the object, and o its image on the ground

* Professor Sylvanus Thompson and E. Abbe have designed instruments for the determination of the position of the Gauss points. They are, however, expensive, and not likely to be within reach of the ordinary worker.

glass.) Now, on that same first page of the optical text-book will be found another very elementary rule, which says that the size of the image bears the same proportion to the size of the object as the distance of the image from the lens does to the distance of the object from the lens—so $\frac{i}{o} = \frac{d}{p}$ but $\frac{i}{o} = m$. Therefore

$$m = \frac{d}{p} \text{ .... (iii.)}$$

By (iii.) we are enabled to eliminate p from equation (ii.) by substituting $\frac{d}{m}$ for it, and thus obtain a result that will be serviceable to us, viz.:—

$$f = \frac{d}{m + 1} \text{ .... (iv.)}$$

and

$$d = f\,m + f \text{ .... (v.)}$$

Let us take (v.) first. Here we see that, in order to find the distance a lantern must be placed from a screen, it is only necessary to multiply the magnifying power by the focus, and afterwards add the focus. Example:—Find the distance a lantern lens must be placed from a screen to give, with a 9-inch projection lens, a 12-feet disc, the slide mask being 3 inches.

The answer may be obtained by mental arithmetic in the following manner:—

As 3 inches is a quarter of a foot, the magnifying power with that size of mask will always be four times the diameter of the disc in feet. Therefore $m = 12 \times 4$. Now, f, the focus, is three-quarters of a foot, therefore $f\,m$ is $\frac{3}{4} \times 12 \times 4$. The 4's cancel out, leaving 3×12, to which must be added the focus. The final result is $36\frac{3}{4}$ feet. If we require a 10-foot disc, with a 6-inch lens, we shall have $\frac{1}{2} \times 10 \times 4$, and, adding the focus, we obtain $20\frac{1}{2}$ feet, the distance required. If we use a 12-inch projection lens, we have only to multiply the disc in feet by 4 and add 1.

It will now be probably admitted that the optical and more accurate method when expressed in this form is as easy, if not easier, than the less accurate geometrical, or pinhole, method, as given in the text-books. But some may say that formula (v.) is the same as (i.), with only the addition of the focus. This is perfectly true;

but we reply, first, that the simplification given above, viz., that of employing the terms $f\,m$ in place of their equivalents, $\dfrac{\text{disc} \times \text{focus}}{\text{mask}}$ has never even been hinted in the text-books; and, secondly, that the argument by which $f\,m + f$ is obtained is based on true optical principles, and by no manner of means could it have been evolved out of the pinhole method.

There is yet another erroneous statement which one often meets with in connection with the pinhole treatment of the subject: this is, that "double the size of the disc is obtained by doubling the distance of the lantern from the screen." Careful measurements will show that it is not the fact. The optical formula states that it is necessary to subtract the focus after doubling the distance. Example:—With a 9-inch projection lens, a 10-foot disc is obtained at a distance of 30 feet 9 inches. What distance will be required for a 20-feet disc? Double 30 feet 9 inches is 61 feet 6 inches. Less the focus is 60 feet 9 inches, the correct distance.

To ascertain the focus of a lens—be it a microscope objective, or lantern projection lens, or ordinary camera lens—the procedure is equally simple. Care must be taken to make d large, then all that need be done is to divide d by the magnifying power plus one (formula iv.). Thus, if the magnifying power is 40, and d is $20\frac{1}{2}$ feet, $f = \dfrac{20\frac{1}{2}}{41} = \frac{1}{2}$ foot.

The above arithmetical results are sufficiently accurate for lantern and other general purposes; nevertheless, some of our members would perhaps prefer an alternative and more mathematical treatment of the subject, and yet one which would not involve the trouble of procuring the necessary data required for the calculation of the Gauss points. Let s be the distance between i and o, viz., between the screen and the slide. Then $s = d + p$, and, by (iii.) above, $p = \dfrac{d}{m}$; combining these, we have

$$d = \frac{ms}{m+1}$$

but by (v.)

$$d = f\,(m+1)$$

then

$$f\,(m+1) = \frac{ms}{m+1}$$

therefore

$$f = \frac{ms}{(m+1)^2} \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{(vi.)*}$$

In order to be consistent with our title, this must be construed into arithmetic.

Multiply the magnifying power by the distance between the image and the object, and call the product A.

Add one to the magnifying power, and multiply the result by itself, and call the product B. The focus is found by dividing A by B.

This last formula (vi.) is perhaps the most accurate of all apart from the determination of the Gauss points. The only error consists in the measurement of s, for m can be ascertained with perfect exactness. The distance s in the case of a 9-inch-focus lantern lens will probably be only $1\frac{1}{2}$ too much; this small amount, if s is considerable, will hardly affect the final result.

In microscope objectives the Gauss points are sometimes crossed over; in these cases s will be too small. The error would, however, seldom amount to half an inch; then, if S were made 100 inches, the final error would not be appreciable. A longer distance than this might be selected for s with low powers. Before concluding, we might for a moment give our attention to p, or the "back focus," a term we succeeded in getting rid of at the beginning. It is sometimes useful in lantern and camera work to know p, but perhaps less so in the case of a microscopic objective.

By (iii.) we learn that $p = \frac{d}{m}$; then, by substituting for d its value in (v.), we have

$$p = f + \frac{f}{m}.$$

Therefore, p, the "back focus," is the "equivalent focus," increased by a quantity equal to $\frac{f}{m}$, viz., the focus divided by the magnifying power. The larger the magnifying power, the less will p exceed f; thus, when the screen is at an infinite distance, the magnifying power also becomes infinite, and $\frac{f}{m} = o$; therefore, p is as small as possible, and is equal to f. But, as the screen approaches the

* Chas. R. Cross. M.M.J. Vol. 4. (1870) p. 151.

lens, the magnifying power becomes less, and $\frac{f}{m}$ becomes greater; when the magnifying power becomes 1—that is, when the image is the same size as the object—then $\frac{f}{m} = f$, and $p = 2f$, or twice the focus. The value of p, in terms of s, may be found in the same manner as we obtained that of d above. Thus, $s = d + p$, $d = p\,m$; combining, we have

$$p = \frac{s}{m + 1}$$

Exception may be taken that the term "lantern lens" has been more often used than that of "microscope objective." The reason for this is that the same argument and language is applicable to both, and lantern examples are, perhaps, more suitable for explanation. Further, this objection should not be made by the members of this Club, as they now possess a lantern of their own. It is, therefore, all the more incumbent on them to understand the optical theories connected with it as well as with the microscope.

Finally, let me point out that formula (v.) contains all the necessary data for determining the distance of either the image or the object for purposes of enlargement or reduction. The rule is: Add one to the times of enlargement, and multiply the result by the equivalent focus. The back focus, p, has been fully discussed above.

In putting forward these few elementary notes, I trust that they will prove equally useful to all three branches of workers, viz., microscopists, lanternists, and photographers.

PROCEEDINGS.

March 2nd, 1894.—Conversational Meeting.

The following objects were exhibited :—

Abutilon, sp., stellate hairs on leaf ...	Mr. G. E. Mainland.
Achnanthes inflata, from R. Lea, Hertford	Mr. H. Morland.
Foraminifera. Internal casts from Macassar Straits	Mr. B. W. Priest.

March 16th, 1894.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., etc., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and elected members of the Club :—Mr. Archibald Bird, Rev. G. H. Culcher, M.A., Mr. John Spink, Mr. W. D. Standfast, and Mr F. W. Teversham.

The following additions to the Library and Cabinet were announced :—

"Journal of the R.M.S."...	From the Society.
"La Nuova Notarisia"	In Exchange.
"The Essex Naturalist"...	,,
"Proceedings of the Geologists' Association"...	,,
"Proceedings of the Belgian Microscopical Society"	,,
"American Monthly Microscopical Journal"	,,
"The Microscope"	,,
"Le Diatomiste"...	,,
"Anatomy of the Blow Fly," Part 5 ...	
"Transactions of the Wisconsin Academy of Sciences."	
37 Slides of Diatoms	From Mr. Morland.

The Secretary said that the last-named donation would be of special value. The contents of the Cabinet were under revision, and Mr. Morland, whose skill as a mounter of these objects was

well known, had kindly presented these to add to the completeness of their set. He felt sure that this gift would be highly appreciated by those members who worked in that direction, because these were not merely 37 diatom slides, but 37 *Morland* slides.

The Chairman said they would be glad to see that Part 5 of Professor Lowne's book on the blow fly was published, and to know that there was a prospect of the work being finished before the end of the year. He had not yet received his own copy, but on looking into the one upon the table he noticed that amongst other things it dealt largely with Mr. Lowne's favourite subject, "The Compound Eye." The slides of diatoms to which Mr. Karop had drawn attention were of great value to the Club, and could not be passed without special notice.

A special vote of thanks to Mr. Morland was accordingly, on the motion of the Chairman, unanimously carried.

The Chairman said that it would be within the knowledge of all those members who were in the habit of attending the excursions that there had been a feeling amongst them of a desire to express in some tangible method their sense of indebtedness to Mr. Parsons, who had for a space of over ten years so ably laboured to make them a success. This feeling was not confined to those who attended the excursions, but was shared in by many others, who, from want of time or other causes, were unable to go to them, but who nevertheless desired to recognize their appreciation of the services which Mr. Parsons had in this way rendered to the Club. He greatly regretted that, owing to an attack of influenza, their President was unable to be present that evening, but in his absence it devolved upon him to present to Mr. Parsons, on behalf of his fellow members, this slight token of their sense of indebtedness to him. In addition to this testimonial, consisting of a suitably engraved gold watch, one of the members, Mr. Rousselet, had also given for presentation to Mr. Parsons a set of slides illustrative of some of the "pond life" so associated with the results of their excursions.

Mr. Parsons said he felt very deeply the great honour which had been done to him in the presentation of this testimonial, but hoped he should be excused from making any speech, to which he felt entirely unequal on that occasion. He desired, however, very heartily to thank those who had been concerned in the matter, and to assure them that though unable to do justice to his feelings he

trusted they would accept his assurance that both the gift and the feeling which had prompted it would be very highly valued by him.

Mr. C. L. Curties exhibited Leitz's projection microscope, and explained the method in which it was employed, both for photography and for the drawing of objects placed upon the stage.

The Chairman thought this appeared to be a useful and handy arrangement, and one which certainly possessed considerable novelty. The sketching table scarcely looked as if it was very conveniently arranged, although for rough purposes it might answer fairly well. He did not know whether it would be found useful also for delicate objects.

Mr. Karop exhibited and described a new biological microscope brought out by Mr. Swift, which was much the same in general design as the one he brought out a short time ago, but it had been greatly improved in the matter of steadiness by the alteration in the foot, in which it would be seen there was now a double support at the back; this double leg being pivoted to the body would readily adapt itself to any surface upon which it was placed.

The Chairman said this double hind foot was certainly a novelty, and though it gave the idea at first sight that it would be less likely to be steady than one which rested upon three points, yet the way in which this was fitted seemed to give it the advantage of the steadiness of a tripod without its liability to tilt.

The thanks of the Club were voted to Mr. Curties and Mr. Swift for sending these instruments for exhibition.

A paper by Mr. E. M. Nelson, "On the Determination of the Foci, etc.," was taken as read, and on the motion of the Chairman a vote of thanks was passed to the President for his communication, which would be found very instructive when printed in the Journal.

Mr. H. W. King read a paper on "Amœboid Attributes."

Mr. J. D. Hardy was glad that a paper had been read which treated of pond life from a histological point of view. With reference to this paper the main points appeared to be the abnormal elongations or projections of the pseudopodia of these West Indian Amœbæ and the specialized "attributes" given to the protoplasm. The pseudopodia were described as being composed entirely of ectosarc; this implied a power at the will of the creature to differentiate its protoplasm, a theory which could hardly be accepted

without some proof by experiment or observation directed to this special object. If Mr. King had such proof he should be glad to hear it.

Mr. King said he had noticed that the ectosarc was extended independently of the endosarc, and that in many cases it remained quite quiescent; the motions were quite distinct one from another. He thought they had quite distinctive attributes.

The Chairman thought it was evident that Mr. King believed in Mr. Herbert Spencer's theories of the inheritance of acquired characteristics; not being a specialist in this particular direction he had not been able to bring his mind to believe in the large number of kinds of Amœbæ which specialists seemed to find; but there was in his mind a strong suspicion that many things called species were dependent upon the conditions which surrounded the object at the time it was examined. One thing in Mr. King's remarks struck him as being extremely doubtful, and that was the idea that there was any form of life whatever which was dependent upon some sort of accident, because it appeared to him that Nature had all through a special means of transmitting life, and it was only when the conditions were altered, as, for instance, in the case of an imported plant when one sex only was brought over, that they could be said in any way to depend upon accident. When, for instance, the scarlet runner was first imported it was for the sake of the flowers, because coming from a country where there were no bees it never produced fruit; but when it was grown here and the bees fertilized it then it produced beans. If there was one thing that was constant throughout Nature it was that every species had its own natural conditions of life and its own mode of reproducing itself.

Announcements of meetings and excursions for the ensuing month were then made, and members were reminded that the conversazione mentioned at their last meeting would take place on May 4th.

The following objects were exhibited:—

Sections of Basaltic Rocks from the Volcanoes of Mauna Loa and Kilanea, Hawaii	Mr. G. Smith.

April 6th, 1894.—Conversational Meeting.

The following objects were exhibited :—

Meridion circulare	Mr. G. E. Mainland.
Brachionus pala (mounted)	Mr. C. Rousselet.

April 20th, 1894.—Ordinary Meeting.

A. D. Michael, Esq., F.L.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Mr. F. W. Lewis and Dr. W. McLeod were balloted for and duly elected members of the Club.

The following donations to the Library were announced :—

"Transactions of the Botanical Society of Edinburgh"	From the Society.
"Report and Proceedings of the Ealing Microscopical Society" ...	"
"Annals and Magazine of Natural History"...	Purchased.

The thanks of the Club were returned to the donors.

Mr. J. G. Grenfell read a paper on "*Eudorina elegans*," illustrating the subject by diagrams and specimens shown under the microscope.

Mr. Rousselet said that the extraordinary appearance and disappearance of these things was most remarkable. Three weeks previously there had been any quantity of them to be got, and a week ago they were all gone, although in the same place there had been millions the week before.

The Chairman thought Mr. Grenfell's paper had been of much interest, both as describing what he had seen, and as suggesting explanations of what appeared to be new observations. He thought that if there was a layer of mucus surrounding the object, as was the case in most instances, this would supply a reasonable explanation of the fact that the two flagellæ should appear to separate at a little distance from the exterior of the creature, instead of immediately at the surface ; he could not, however, quite follow Mr. Grenfell in calling this investing envelope a cuticle. On looking at the slide exhibited in the room he was unable to make out the three layers which appeared to be the crucial point, but this, of course, did not at all imply that they were not there, because when working at an object of this kind

it would be quite possible to see in a quiet room at home what could not be detected under present conditions.

The thanks of the meeting were voted to Mr. Grenfell for his paper.

Mr. R. T. Lewis said that he exhibited at the last meeting of the Club some curious eggs, together with the larvæ which were hatched out of them. The eggs were laid upon the bark of a tree, they were pure white, oval in shape, each one being mounted upon a short stalk, and having the free end covered with an operculum bearing a small knob-like elevation, suggesting a resemblance to the cover of a china teapot. The larvæ were very curious also, differing in the character of the mouth organs from any others he had met with. The antennæ were three-jointed, with very long terminal hairs, and the mandibles were serrated on both edges and sharp at the points. The larvæ were bright red in colour and very small, averaging about ·037 inch in extreme length. His object in bringing them to the meeting was to get some suggestions from members which might possibly lead to identification. Since then, however, Mr. C. O. Waterhouse, of the British Museum, had met with a figure of it, and has been able to say that it was the larva of *Mantispa*. His correspondents in Natal, from whom the eggs were received, were preparing to make some more systematic observations in these things than hitherto, and had already started a Vivarium, in which they were hoping to be able to rear and trace the life-history of many well-known insects with whose larval forms we were at present unacquainted. Drawings of the eggs and larvæ were handed round for inspection.

The Chairman said these stalked eggs were very curious, but they were not uncommon amongst certain classes of insects, those of the lace wing fly being familiar to most observers. He was glad to hear of the attempt which it was proposed to make to work out the life-history of these creatures, because there was more lacking in respect of this class of observations than in any other branch of natural history. If Mr. Lewis's friends would devote themselves to this class of observations, they would be doing what was greatly wanted and would be likely to be of great service to entomological science.

It was announced by the Chairman that there would be no conversational meeting held in that room as usual on the 1st

Friday in May, but that arrangements were made for holding a special exhibition meeting on that date at the Freemasons' Hall as on a former occasion. He hoped that every member would do his best to make that meeting a success.

Excursions, etc., for the ensuing month were announced, and the meeting closed with the usual conversazione.

May 18th, 1894.—Ordinary Meeting.

Albert D. Michael, Esq., F.L.S., etc., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. J. H. Evans, Mr. W. Sutton, and Mr. L. Miles.

The following additions to the Library were announced:—

"Journal of the Royal Microscopical Society"	From the Society.
"Transactions of the Scientific Society of Chili"	" "
"Transactions of the Canadian Institute" ...	" Institute.
"Annals and Bulletin of the Belgian Microscopical Society"	" Society.
"The Botanical Gazette"	" Editor.

Mr. C. L. Curties exhibited a new apparatus for obtaining instantaneous photographs of objects under the microscope, and described the methods of using it. Some excellent photographs of *Lophopus*, and also of blood globules taken with it, were handed round for inspection. He also exhibited and described a new form of microscope made for photographic purposes at the suggestion of Mr. Hartney Turner, of Manchester.

The Chairman said that instantaneous photography of living objects under the microscope was a new departure, and was one likely to be very useful, especially if it was found possible to develop it in the direction of taking a series of pictures of rapidly-moving creatures, on the same principle as had been carried out in the cases of the running horse and the flying bird. The specimens shown by Mr. Curties were extremely good and sharp, and the idea

seemed to give promise of the possibility of getting views which might help them better to understand the movements of many active organisms which it was otherwise difficult to follow. It also seemed to him likely to be useful as an aid to drawing many of these objects, as by this means the true outlines might be obtained, which could afterwards be filled in by hand.

Mr. Western read a paper entitled "Some Notes on Rotifers," in the course of which he mentioned many interesting points recently observed in connection with these organisms.

Mr. Rousselet said he had nothing to add to the notes read by Mr. Western, but he should like to remark upon the extraordinary appearance and disappearance of some of these forms. One which was described by Ehrenberg had never been found since his time until quite lately, when it reappeared in various parts of Europe as well as in America, the consequence being that it had been redescribed under seven different names. Another Rotifer—a very large one, originally described as *Notops Ruber*—had also similarly reappeared, having been found about the same time at places as wide apart as Dundee, Holstein, and also in America. It was not easy to account for this, although some had supposed they might have been lying dormant in the bed of some dried-up lake, until circumstances favoured their distribution. With regard to the preservation of Rotifers, he had made some further progress since his last communication on the subject; his original preservative fluid had been Fleming's solution in a very diluted state, but as this contained osmic acid there were some objections against it, and he had since used what was the same solution without this acid. As regards the fluid for narcotizing, he now used one made from the following formula, which he found answered for all kinds: 2 per cent. cocaine, 30 parts; methylated spirits, 10 parts; water, 60 parts = 100. He hoped by the beginning of their next session to have concluded his experiments in this direction, and to produce a paper on the subject embodying the results.

The Chairman said he was reminded of a remark by a former President of the Club that its *raison d'etre* seemed to be to discover new Rotifers, and if Mr. Western had not on this occasion described any which were actually new, he had at least found some which were new to Britain. He was afraid Mr. Western's experiences as to the variety of descriptions of the same creature were not

altogether novel, for there was a well-known saying which he might quote once more, that when a man discovered a new organism he usually described one thing, figured a second, and sent a third to the British Museum as a type specimen. With regard to small differences it was impossible to rely upon them as determining species unless the life-history of the creature was known, so as to ascertain the extent of the varieties which occurred at different stages; indeed, it was said that one genus, *Tortrix*, contained thirty-six species, but that a gentleman who investigated the matter by rearing them got the whole thirty-six from one brood. The question of the disappearance of the eyes was also a point worth noting, as he had often suspected that these organs were not altogether a reliable character upon which to found species. In many cases they could only be seen by consequence of the pigment under the surface, and if that became dissolved or detached it was extremely difficult to detect them, or to say whether they existed. In several species of marine mites where Gosse had figured them with eyes others had figured them without, and he had himself seen specimens where the eye could be easily perceived on one side but not on the other.

The thanks of the meeting were, upon the motion of the Chairman, unanimously voted to Mr. Western for his paper.

Announcements of meetings and excursions for the month were then made, and the Secretary said he had been requested to intimate that the Selborne Society proposed to hold a *soirée* in that room on May 30th, and would be glad of help from members of the Q.M.C.

The following object was exhibited :—

Delphax (sp. ?) ♂ ♀	Mr. H. E. Freeman.

June 1st, 1894.—Conversational Meeting.

The following objects were exhibited :—

Seira nigromaculata, scales	Mr. A. W. Dennis.
Proales parasita (mounted)	Mr. C. Rousselet.
Clavatella prolifera	Mr. H. Scherren.

June 15th, 1894.—Ordinary Meeting.

E. M. Nelson, F.R.M.S., President, in the Chair.

The President said he could not resume his seat without thanking the members for the very kind sympathy he had received from all quarters, and he hoped that they would accept this expression of his gratitude.

Mr. Veysey, in the absence of the Hon. Secretary, read the minutes of the previous meeting, which were duly confirmed.

The Hon. Sir Ford North and Mr. W. J. Morton were balloted for and elected Members of the Club.

The following additions to the Library were announced:— "Le Diatomiste," "Proceedings of the Belgian Microscopical Society," "Annals of Natural History."

The President had much pleasure in communicating a little incident. He met Professor Rupert Jones, an old friend of John Quekett, who asked how the Quekett Club was getting on. He replied the Club was in a flourishing condition. The Professor gave him some slides for the Club cabinet. These were very old slides of foraminifera, prepared in the early days of microscopy by W. Kitchen Parker, between 1845 and 1850, which gave them additional interest. He proposed a hearty vote of thanks to the Professor for his contribution, which was carried with applause.

Mr. Western, in reading a paper on a new species of Rotifer, *Distyla spinifera*, said he thought he ought to apologise for intruding himself again upon the Club so soon. His excuse was, he had a new Rotifer which he was anxious to introduce to the Club before their Continental friends got hold of it. He then gave a description of the Rotifer, with sketches on the black-board.

Mr. Scourfield read a paper on a daphnia, *Ilyocryptus agilis* (Kurz).

The President invited discussion on the papers.

Mr. Hardy remarked that he thought one feature which might be useful for purposes of identification was the different outlines of the feeding arrangements. The funnel, if one might so term it, or syphon, with which the daphnia took its food differed materially in most of them. He wished to call Mr. Scourfield's attention to the fact.

Mr. Scourfield said he did not find this point of any value for

purposes of identification, except in the aberrant form of *Leptodora hyalina*.

Mr. Ingpen, in introducing the subject of "Iridescence," said his remarks must be considered a stop-gap. At the same time, it might not be improper to call attention to the work of others.

Mr. Ingpen, remarking that when original papers were scarce it was sometimes worth while to draw attention to published works which might assist in opening out useful and interesting lines of research, gave an account of Dr. Hodgkinson's papers on "Iridescence," which had been communicated to the Manchester Literary and Philosophical Society in April, 1889, and March, 1892.*

The characteristics of minute structures were considered :— I. *Microscopic* structures, those that are amenable to ordinary microscopic examination, shown chiefly by pigment or absorption colours. II. *Ultra microscopic* structures, in which the microscope is used as an aid to the observation of the optical effects of reflection, refraction, absorption, polarization, and various interference phenomena. III. *Hyper-photic* structures, which from their physical nature are unsuited for investigation by any known optical method, of which lamellæ in optical contact, *i.e.*, separated by intervals of less than a quarter of a wave-length, and transparent particles, capable of producing opalescence, are examples. Iridescence was considered to be produced by thin plates, by fine lines, and by the combination of both structures. In the case of thin plates or films, the light transmitted is in the axis, or parallel to the axis of the illuminating beam, and is coloured. The colour is confined to the direction of the illuminating beam, and changes with the tilting of the film in altitude. In the case of fine lines there is a central colourless image of the source of light, accompanied by a series of diffraction spectra at right angles to the direction of the lines. These effects are largely modified by dots or irregularities tending to produce opalescence.

Methods of observation were described. For transparent objects a stage with a pin-hole aperture close below, upon which a one-inch objective was focussed, and means by which the object could be rotated in azimuth, and tilted in altitude, formed a convenient arrangement. For illuminating minute opaque objects a beam of

* Ser. iv., Vol. ii., p. 193; Vol. v., p. 149.

light could be projected by means of a mirror down one of the tubes of a binocular microscope. For large objects a laryngoscope mirror was very effective for obtaining illumination at a normal incidence.

Objects suitable for examination are numerous, or perhaps innumerable. Of thin plates—mica films, minerals that show cleavage, feathers of humming-birds, scales of fish, beetles and butterflies are examples. Structures showing fine lines—artificial, as in diffraction plates—or edge views and folds of thin plates, as in mother-of-pearl. Mixed cases, as shown by white flowers in sunshine, opal, felspar, etc., etc.

Instances of the utility of the study of iridescence were noticed. In the case of humming-birds it was desirable to be able to describe their colours according to some uniform method. This could be done by recording the colour shown by light reflected at normal incidence, when the colour is found to be unvarying, disappearing when the object is moved, but absolutely unchanged in tint. Such colours could be described as iridescent red, orange, green, etc. Accuracy in colour nomenclature, and establishment of standards of colour-comparison, would be assisted by these methods of examination, and help would also be rendered in the investigation of complex structures, for which ordinary microscopic observation is inadequate.

The President invited observations on Mr. Ingpen's very interesting communication. He thought the Club owed their thanks to Mr. Ingpen for bringing the subject before them. Objects under the microscope lost nearly all colour. The diatom *Pleurosigma formosum* flashes colours in sunlight, but under the microscope it appears white. The resolution of structure is always accompanied by loss of colour. It was really most beautiful and interesting to look at iridescent colours given by ordinary bodies viewed in suitable light. He had seen a number of jelly fish at the end of a pier in deep water, against a dark background, and the bright sun shining on their cilia gave a most magnificent play of colours. He also referred to the beautiful colours on a soap bubble, which were produced by the thinness of the film. The wing of the dragon-fly also gave a beautiful tint for the same reason. The most gorgeous colours, as Mr. Ingpen had said, were found on the humming-birds. There was a fine collection at the British Museum, which might be studied with advantage. One

little humming-bird he had seen in Brazil had a tuft on each side of its head, which flashed in sunlight brighter than any gem. The chart which accompanied Dr. Hodgkinson's paper was a very deep thing. It could not be taken in at a glance, for it required study; it showed that by analysis of the spectrum it was possible to find out to which order the tint belonged, and also to calculate the thickness of the film.

The excursions and meetings for the ensuing month were announced, and the meeting closed with the usual conversazione, when the following objects were exhibited:—

Segestria senoculata, Palpus of Spider ...	Mr. H. E. Freeman.
Craterium vulgare	Mr. J. D. Hardy.
Conochilus volvox (mounted)	Mr. C. Rousselet.

JULY 6TH, 1894.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Conops quadrifasciata, Antennæ	Mr. H. E. Freeman.
Campylodiscus echeneis	Mr. H. Morland.
Ploesoma Hudsoni	Mr. G. Western.

SEPTEMBER 7TH, 1894.—CONVERSATIONAL MEETING.

The following objects were exhibited:—

Bipennaria stage of a star-fish ...	Mr. E. T. Browne.
Selenastrun bibraianum	Mr. A. Jenkins.
Stictodiscus Kittonianus	Mr. H. Morland.

SEPTEMBER 21ST.—ORDINARY MEETING.

E. M. NELSON, Esq., F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed. Mr. J. Pollard was balloted for and duly elected a member of the Club.

The following donations, etc., were announced:—

"The Microscope"	From the Editor.
"The Monthly Microscopical Journal"	" "

"Proceedings of the Academy of Sciences of Philadelphia"...	From the Society.
"Annals of Natural History"... ...	Purchased.
"Journal of the Royal Microscopical Society"	From the Society.
"Quarterly Journal of Microscopical Science"	Purchased.
"Proceedings of the Royal Society of New South Wales" ...	From the Society.
"Proceedings of the Chester Society of Natural Science and Literature"	" "
"Ponds and Rock Pools"	From the Author.
Paper "On Investigations as to the Composition of the Air in the Sewers of Sydney" ...	" "

The thanks of the meeting were voted to the donors.

Mr. C. Rousselet read a note "On *Cyrtonia tuba.*"

Mr. D. Bryce read a paper "On *Macrotrachelous Callidinæ,*" being the third of his series of papers on the Callidinæ.

Mr. G. Western thought they owed Mr. Bryce a very hearty vote of thanks for the very excellent paper which he had just read. He had made this class his special study, and the Society was greatly to be congratulated upon being able to publish a paper of such value in their Proceedings.

The President was sure that the members present would cordially agree with what Mr. Western had said, and would unite in thanking Mr. Bryce for his valuable communication. Their thanks were also due to Mr. Rousselet for his further contribution to their knowledge on the subject of Rotifers.

Votes of thanks to Messrs. Rousselet and Bryce were unanimously carried.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated.

The following objects were exhibited :—

Parasites found on a Penguin ...	Mr. R. T. Lewis.
Cyrtonia tuba (mounted)	Mr. C. F. Rousselet.

QUEKETT MICROSCOPICAL CLUB.

List of Exhibits at a Special Meeting held at Freemasons' Tavern, May 4th, 1894.

Mr. J. M. Allen...	*Asplanchna priodonta* and other pond-life.
Mr. F. W. Andrew	*Cristatella mucedo,* pappus of Taraxacum, seed of parsley.
Mr. Ashmore Baker ...	Various objects, polarised.
Mr. F. W. Baxter ...	*Terpsinoë intermedia,* sporangial form.
Mr. W. E. Baxter	Sect. limestone from Sendai, showing diatoms *in situ.*
Mr. W. A. Bevington ...	Various crystals, polarised.
Mr. A. W. Bird ...	*Conochilus volvox.*
Mr. W. Burton ...	*Perophora Listerii*; Asplanchna and other pond-life.
Mr. W. I. Chapman ...	*Stephanoceros Eichornii.*
Mr. A. Cottam	Selected diatoms.
Mr. T. R. Croger	*Serpula pectinata,* Diatoms on Coralline, Group of Seeds.
Mr. E. Dadswell ...	*Plumularia halecioides.*
Mr. J. A. Daniell ...	*Daphnia pulex.*
Mr. A. Dean ...	Multiple images in compound eye of Dyticus.
Mr. A. W. Dennis ...	Hippuric Acid, polarised.
Mr. J. Dick	*Hydra vulgaris* ; Polycistinæ.
Mr. G. P. Dineen ...	*Hydra viridis.*
Mr. C. G. Dunning	*Limnocodium Sowerbii, Phylobius maculicornis.*
Mr. A. Earland	Grouped Foraminifera.
Mr. F. Enock	Eyes of Jumping Spider.
Mr. T. D. Ersser ...	Circulation in web of Frog's foot.
Mr. F. W. Eyre ...	Elytron of *Hypomeces squamosus.*
Mr. H. E. Freeman	Serial sections of Spiders, Insect dissections, etc.
Mr. F. Goddard ...	*Volvox globator.*
Mr. H. Groves	Cyclosis in *Nitella flexilis.*
Mr. W. Hainworth ...	Peristome of *Funaria hygrometrica.*
Mr. A. R. Hammond ...	Series of drawings of Insects.

Mr. J. D. Hardy	...	Electric spark.
Mr. F. W. Hembry	...	Aphidæ on Berberis.
Mr. G. Hind ...	...	Section of pebble, polarised.
Mr. J. Holder ...	...	Plumose head of Gnat.
Rev. R. Hollis ...	...	A Cape Diamond.
Mr. J. E. Ingpen	...	Specimens of Leaf staining.
Mr. A. J. Jenkins	...	Foraminifera and Diatoms.
Mr. J. Kern ...	...	Rotifers and other pond-life.
Mr. H. W. King	...	Cyclosis in Vallisneria.
Mr. J. W. Lasham	...	Hydrozoa.
Mr. R. T. Lewis		Compd. eyes and ocelli of Cystocælia; "Brushes and Combs" on leg of African Ant.
Mr. S. von Lösecke	...	*Melicerta ringens*, *Fredericella sultana*.
Mr. R. Macer ...	...	Stephanoceros and other pond-life.
Mr. C. Machin ...	...	*Lophopus crystallinus*.
Mr. G. Mainland	...	Anthers and pollen of Arbutilon.
Mr. H. Morland	...	Section, petiole of *Pontederia cærulea*.
Mr. C. Muiron	...	*Brachionus pala*; Volvox, etc.
Mr. E. T. Newton	...	Brachiopod mantle, polarised.
Mr. J. M. Offord		Diatoms from Sta. Monica and Glengore.
Mr. T. Orfeur ...	...	Tongue of *Vespa vulgaris*.
Mr. F. A. Parsons	...	Stentors, Tardigrada, etc.
Mr. T. Powell ...		Cyclosis in Vallisneria, $\frac{1}{10}$ Apo and $\frac{1}{4}$in. ocular, × 1000 diam.
Mr. B. W. Priest	...	*Euplectella aspergillum*, spicules.
Mr. F. Reeve	...	Sections of Wood, Stems, etc.
Mr. C. Rousselet	.	Pond-life, living and mounted.
Mr. J. Russell ...	...	Hydra, Vorticella, etc.
Mr. W. E. Samson	...	Peristome of Moss; Hydra.
Mr. J. Slade ...	...	Sections, seeds of Umbelliferæ.
Mr. W. Smart ...	...	Circulation in Antenna of Asellus.
Mr. A. Smith ...	...	Crystals, polarised.
Mr. C. D. Soar	...	Groups of Diatoms.
Mr. W. H. Southon	...	Rotifers.
Mr. A. T. Spriggs	...	Australian Sea-weeds, etc.
Mr. A. W. Stokes	...	Eyes of Gerris, etc.
Mr. E. Swain ...	...	*Campanularia angulata*.
Mr J. Terry ...	...	Marine Polyzoa.

Mr. J. J. Vezey	...	Arranged Butterfly Scales, etc.
Mr. J. E. Webb	...	Actinosphærium, Arachnoidiscus, etc.
Mr. C. West ...	...	Dissections of Vespa and Dytiscus.

Six tables of Microscopes with objects were exhibited by Messrs. Baker, Beck, Johnson and Sons, Steward, Swift and Son, and Watson and Son.

Attendance: Members, 140; Visitors, 390; Total, 530.

New Books.

We have received from Messrs. Williams and Norgate a copy of the German translation of Dr. E. Giltay's "Hoofdzaken uit de leer van het zien door den microscoop," an elementary work on the fundamental laws of microscopic vision exemplified by seven objects. After a short introduction on the instrument itself, taking as types Zeiss's No. 14 and No. 4*a*, which he supposes to have come into the hands of an absolute novice, Dr. Giltay proceeds to an examination of the seven objects chosen, beginning with simple lines drawn in ink on the surfaces of an ordinary slide and cover glass, which are successively viewed by a low and moderately high power. He explains the alteration in the image produced by focussing, the depth of the focal plane diminishing with the power, the inversion of the picture, and so forth. The next object consists of pieces of glass thread painted with two tints of Indian yellow and examined immersed in cedar oil; by means of these is shown how the shallowness of the focal plane bears on the question of microscopical perception and what is implied by the term optical section. Starch and then air-bubbles are next considered, and the latter, with the interpretation of the phenomena they exhibit under the microscope, forms, perhaps, one of the most important sections of this little book for the ordinary observer. Milk and collenchyma are the fifth and sixth objects, and the seventh and last is Abbe's diffraction plate. From the purely optical point of view this deserves, and should obtain, the close study of all intending microscopists who wish to understand the relations of aperture to power and the laws bearing on the resolution of minute structures, as primarily enunciated by Abbe. The theory of immersion objectives is included in this section. For such as read

German the booklet may be cordially recommended. Its price is half-a-crown.

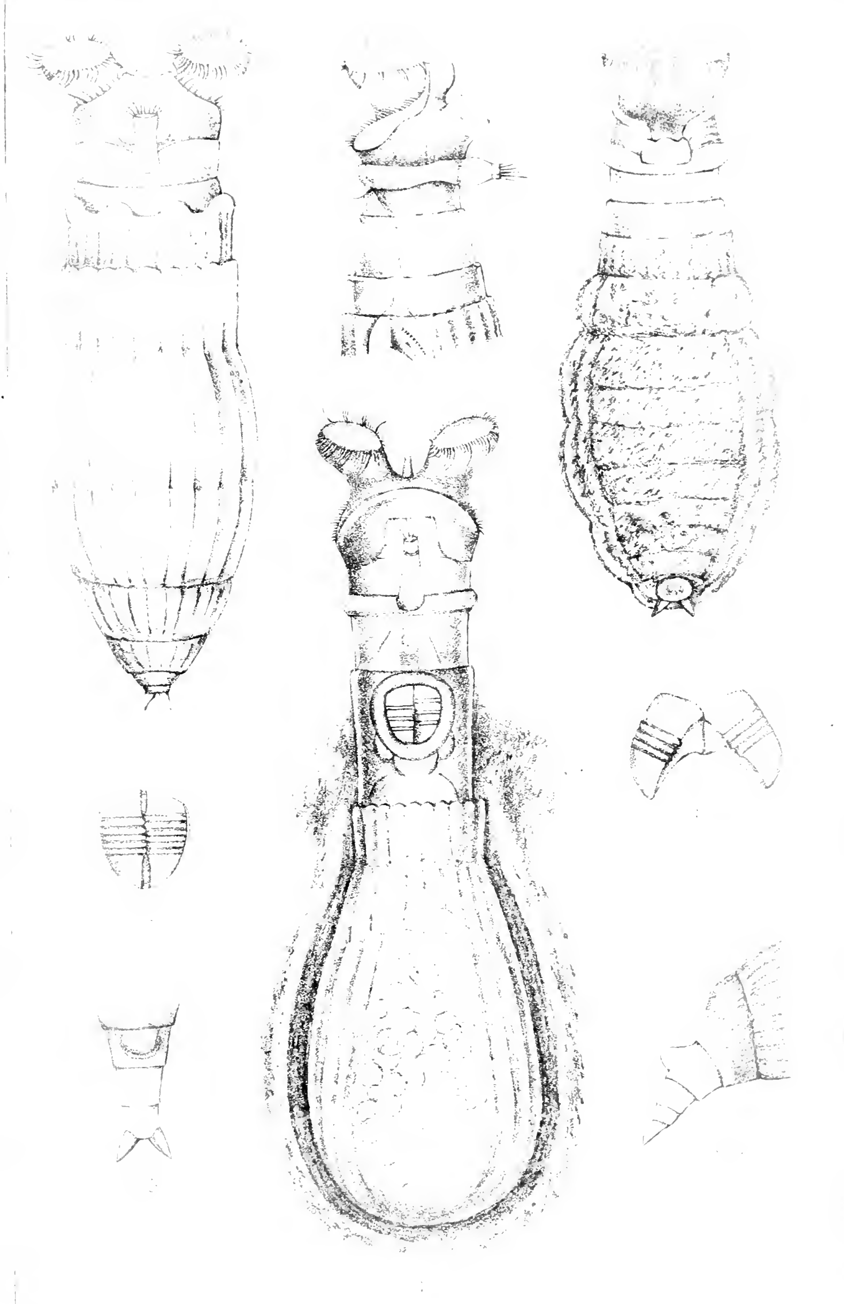
Ponds and Rock Pools, by Henry Scherren (published by the Religious Tract Society).—This little book of 204 pages of text, with numerous illustrations, is very well written and conveniently arranged, and it can be recommended to all beginners in pond hunting. They will find therein a description of all the chief appliances for, and methods of collecting, capturing, and examining micro-organisms, which are used and practised by the experienced workers in this field, as well as a description of a number of objects, chiefly animals, usually met with in ponds and sea-side pools.

The headings of the six chapters will best give an idea of the scope of the book: Chapter I., Pond and Rock-pool Hunting; Chapter II., The Beginning of Life; Chapter III., Sponges and Stinging Animals; Chapter IV., Worms; Chapter V., Starfish, Arthropods, and Molluscs; Chapter VI., The Micro-aquarium.

The illustrations are mostly very well selected as types of the respective groups of animals; the figure on page 123, however, must be criticized: the Rotifer represented seems to be a cross between *Brachionus pala* and that variety of *Brachionus bakeri* known as *brevispinus*, and we must seriously doubt that the author has ever met with such an animal. If the figure represents *B. pala*, then the posterior part is wrong, and if it is to stand for *B. brevispinus*, then it ought to have six spines anteriorly, instead of four, and of somewhat different shape.

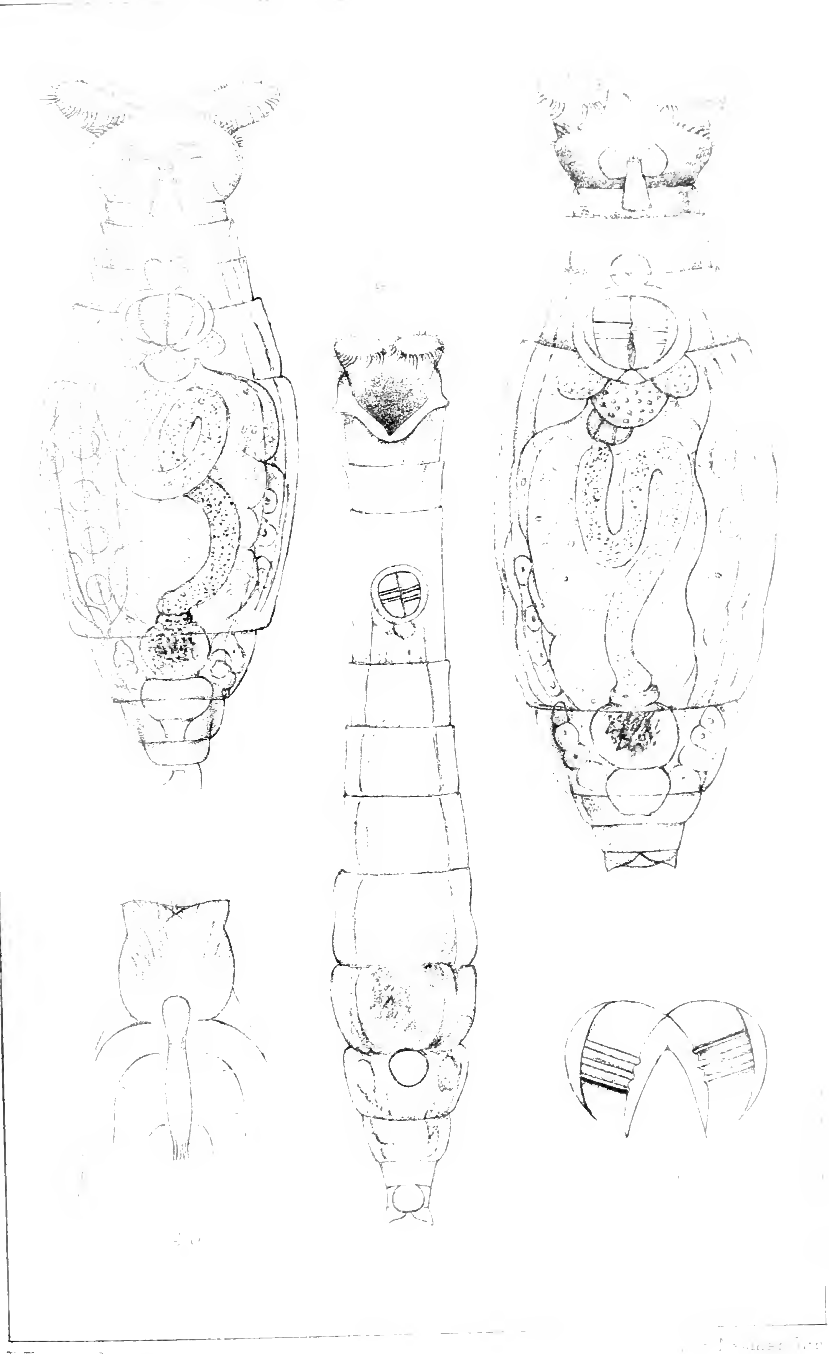
Such slight defects will, however, not detract from the value of the book to those who wish to use it and profit by the mass of useful information brought together with much labour, and concisely stated. A better book could not be placed in the hands of a young naturalist eager to know how to catch his game and what to do with it afterwards. Its price is half-a-crown.

NOTE.—The catalogue of the Williams Collection has been printed and may be obtained from the Hon. Curator, Mr. E. T. BROWNE, F.R.M.S. Price 6d.



D. Bryce ad nat. del.

West Newman lith.



D.Bryce ad nat. del.

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(It will be understood that the Authors alone are responsible for the views and opinions expressed in their papers.)

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MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

FOR 1892, AT THE

Royal Medical and Chirurgical Society,

20, Hanover Square, W.,

ON THE

FIRST and THIRD FRIDAYS of EVERY MONTH.

THIS CLUB was established in 1865 for the purpose of affording to experienced Microscopists, as well as to Students, regular and frequent opportunities of discussing those special subjects in which they are mutually interested, and also for promoting Field Excursions to the well-known collecting districts around the Metropolis.

No Entrance Fee. Annual Subscription, 10s., dating from January 1st.

The ORDINARY MEETINGS are held on the Third Friday in each Month except July and August. Business commences at 8 o'clock.

1892.—Friday,	January	...	1	...	15
,,	February	...	5	...	19*
,,	March	...	4	...	18
,,	April	...	1	...	(Good Friday. No Meeting.)
,,	May	...	6	...	20
,,	June	...	3	...	17
,,	July	...	1	...	15
,,	August	...	5	...	19
,,	September	...	2	...	16
,,	October	...	7	...	21
,,	November	...	4	...	18
,,	December	...	2	...	16
1893. ,,	January	...	6	...	20
,,	February	...	3	...	17*

The Meetings on the *first* Friday in each month, and on July 15th and August 19th, are for conversation and for the exhibition of objects, from 7 to 9.30 p.m.

* The ANNUAL GENERAL MEETING will be held on the third Friday in February of each year, at 8 o'clock, for the Election of Officers and other Business.